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MUNICIPAL WATER POLLUTION CONTROL ABSTRACTS:
MAY to OCTOBER 1976

by

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16. ABSTRACT

The Franklin Institute Research Laboratories, Science Information Services Department prepared for the Environmental Protection Agency, Volume 4 of a monthly current-awareness abstracting bulletin, Municipal Technology Bulletin, which dealt with methods of municipal waste water treatment, problems of water quality, and water pollution control. Volume 4 of the Bulletin contained abstracts of technologically significant literature appearing in print between May - October 1976. Under the same grant, the Science Information Services Department provided abstracts, including those appearing in Volume 4, to the Water Resources Scientific Information Center (WRSIC) as a center of competence on municipal waste water for WRSIC. Topics covered in the Bulletin and in the WRSIC input include: analytical techniques for water quality measurements; biological, chemical, and physical methods of waste water treatment; construction and equipment for pollution control; mathematical, statistical, and simulation model studies; storm runoff, tunnelling technology and sewer systems; and, treatment plant operation and automation. This report is a compilation of the abstracts arranged in chronological order by accession number within subject categories.

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ABSTRACT

The Franklin Institute Research Laboratories, Science Information Services Department (SIS), under the sponsorship of the Environmental Protection Agency, has provided 900 abstracts and their corresponding full text copies to the Water Resources Scientific Information Center (WRSIC) data bank. These documents represent current developments in the field of municipal waste water treatment, as described in over 7000 technical journals, reports, and patent gazettes. The Franklin Institute Research Laboratories SIS is a Center of Competence for WRSIC and thus a contributor to their bi-monthly publication *Selected Water Resources Abstracts*. This report includes the 900 abstracts that have been input to the WRSIC data base between May and October of 1976. The abstracts are arranged in chronological order by accession number within eight subject categories. These are: Storm Runoff, Sewer Systems, Patents, Treatment Methods, Analytical Techniques, Model Studies, Hydrologic Aspects, and a Miscellaneous Category. Included are a computer-generated hierarchical subject index, an author index, and a journal list.

Municipal Water Pollution Control Abstracts: May to October 1976 is submitted in fulfillment of grant number R803613-01-3 by the Franklin Institute Research Laboratories under sponsorship of the Environmental Protection Agency. Work was completed as of October 31, 1976.

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INTRODUCTION

Increasingly large amounts of current literature deal with municipal waste water collection, treatment, and disposal. To facilitate the gathering and dissemination of this information, the Science Information Services (SIS) Department of the Franklin Institute Research Laboratories has identified, abstracted, classified, and indexed selected documents in the water resources literature from the six-month period between March and October 1976. This service was made possible through a grant from the Environmental Protection Agency's Office of Research and Development. Material was chosen for abstracting, based on the following subject areas as related to municipal waste water: analytical techniques; sampling and instrumentation; hydrologic aspects; legislation, model studies; patent information; sewer systems; and methods of treatment, disposal and recycling. A total of nine hundred (900) abstracts were input to the Water Resources Scientific Information Center (WRSIC), Office of Water Resources and Technology, Department of the Interior. The present report is a fully indexed compilation of these 900 abstracts and serves as a specialized bibliography on municipal waste water control.

In recent years, the Franklin Institute SIS has produced several related publications for the EPA: *Selected Storm Water Runoff Abstracts*, 1970-1972, and the *Municipal Technology Bulletin (MTB)*, Volumes 1, 2, and 3, in 1973, 1974, and 1975-76, respectively. These publications were designed to meet the needs of officials, researchers, and engineers, and to help them stay aware of recent developments in this field without spending unnecessary amounts of time scanning the literature themselves. Volume 3 of the *Municipal Technology Bulletin* ended with the March 1976 issue; this report serves to fill the gap between Volume 3 and the beginning of Volume 4 of the *MTB* in December 1976.

Relevant literature on municipal waste water for input to the WRSIC data bank is chosen by the regular scanning of over 7000 publications, both domestic and foreign. These documents are technical journals, government reports, industrial reports, newsletters, patent gazettes, design manuals, conference proceedings, recent dissertations, and textbooks. Primary literature is screened at The Franklin Institute Library and several other Philadelphia libraries. Additional screening is performed at The Franklin Institute's facilities in Munich, Germany, and Tokyo, Japan. Specific subject areas covered includes: (1) waste water treatment methods relating to facilities, land application, utilization of sludge, waste water reuse, plant automation, mechanical and chemical devices; (2) biological, chemical, and physical analytical techniques; (3) storm water runoff, including urban runoff, runoff forecasting, flood routing, rainfall-runoff relationships, catchment basins, and surface runoff; (4) sewer systems, including combined, separated, outfall and interceptor sewers, storm drains, infiltration-inflow, materials and equipment; (5) patents for methods and equipment pertaining to waste water treatment, waste water reuse, and waste water disposal; (6) mathematical, statistical, or simulation model studies; and (7) hydrologic aspects involving parametric hydrology, sewer hydraulics, and drainage.

Through this EPA grant, The Franklin Institute served as a center of competence for municipal waste water pollution control. Nine hundred abstracts on municipal waste water treatment methods were provided to the Water Resources Scientific Information Center (WRSIC). These were published in *Selected Water Resources Abstracts*, their semi-monthly abstracting journal, and were entered into their computerized data base. This report includes all 900 abstracts in the format in which they were sent to the WRSIC data base. To improve the ease of using this publication as a specialized bibliography, an in-depth subject index is provided, appearing in a hierarchical, computer-generated form. A complete author index and a journal list are also included. The abstracts are arranged chronologically by accession number within the subject areas. Topic headings are: Storm Runoff, Sewer Systems, Patents, Treatment Methods, Analytical Techniques, Model Studies, Hydrologic Aspects, and Miscellaneous. The format of each abstract is explained on the following page.

FIRL ACCESSION NUMBER

TITLE OF THE ARTICLE

NAME OF THE AUTHOR(S)

AFFILIATION OF SENIOR AUTHOR

BIBLIOGRAPHIC DATA: JOURNAL, VOLUME, NUMBER, PAGINATION, DATE, FIGURES, TABLES, REFERENCES

ABSTRACT OF THE ARTICLE

DESCRIPTORS: THOSE WORDS FOUND IN THE *WATER RESOURCES THESAURUS* WHICH BEST DESCRIBE THE ARTICLE'S CONTENTS. ASTERISKS INDICATE MOST IMPORTANT TERMS.

IDENTIFIERS: THOSE WORDS NOT FOUND IN THE *WATER RESOURCES THESAURUS* WHICH BEST DESCRIBE THE ARTICLE'S CONTENTS.

MUNICIPAL WATER POLLUTION CONTROL ABSTRACTS

Abstracts are arranged chronologically by accession number within each subject area. The subject areas are identified by a letter code:

A - Storm Runoff
B - Sewer Systems
C - Patents
D - Treatment Methods
E - Analytical Techniques
F - Model Studies
H - Hydrologic Aspects
J - Miscellaneous

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A001
EFFECTS OF STORM DISCHARGES ON RIVER WATER QUALITY,

Garland, J. H. N.

ARIC Water Research Centre,
Stevenage, Herts, United Kingdom.

Berichte der Abwassertechnischen Vereinigung e.V., No. 28, p 593-602, 1976.
4 fig, 2 tab, 13 ref.

In 1963, about 37% of the storm overflows in Wales and England were considered unsatisfactory. Pollution problems from storm sewage most frequently appeared where overflow settings were below six times dry-weather flow, usually older industrial urban areas where substantial parts of sewage systems had outlived their original design capacity. Considerable deterioration of water quality in the River Tame resulted from storm overflows and surface drainage. A realistic approach to the problem is that of treating the entire river below the last large effluent outfall using a series of several settling basins. The effect of storm sewage discharge on a river depends primarily on the discharge's duration and strength and the dilution provided by the river. Its strength depends on dry-weather sewage, time of day, time since the last storm, and the flow. In combined sewerage systems, a flood wave precedes the mixed sewage and may cause spillage of dry-weather sewage. If a long time has elapsed since the last rainfall, storm runoff in the first flush may contain very large amounts of suspended solids which had accumulated on surfaces. Discharge duration depends on the intensity and duration of the rainfall, how the overflow weir is set, and the drainage system's storage capacity. The overflow weir setting has the greatest effect on the frequency of pollution episodes. Another problem is posed by metals, such as zinc, copper, and lead, contained in dust entering urban rivers with runoff. The River Tame shows two types of polluted conditions: one caused by inadequate treatment of effluents, and the other caused by additional pollutants entering during storms.

*Storm runoff, *Water pollution sources, Rivers, Sewage treatment, Sewerage, Suspended solids, Weirs

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A002
URBAN DRAINAGE STUDIES,

Koplyay, T. M.

Water and Pollution Control, Vol. 114, No. 1, p 14-16, January, 1976. 1 fig, 2 tab.

New approaches to designing and constructing systems to convey surface waters are being examined, due to increasing land servicing costs. Loss of pervious ground due to land development results in increased storm flow velocities and higher peak flows, causing local flooding. The higher velocities also increase the pollution and sediment loads. The Canada/Ontario urban drainage program was set up to define the stormwater problem in the Canadian Great Lakes region, establish priorities and schedules for studies, and develop a strategy for implementing solutions. A study is being conducted to provide an order of magnitude estimate of pollution loadings from urban runoff. Problem identification efforts also include reviewing existing municipal practices in Ontario. The Storm Water Management Model (SWMM) of the United States Environmental Protection Agency is being adapted to Canadian conditions. Several data collection projects provide site calibration data, and a sub-routine dealing with snowmelt phenomena is being added. Problems with storm sewers and combined sewers in the United States and Europe were studied. Efforts are being made to ascertain that foreign technical practices will be assessed in terms of their applicability in Canada. An ideal model for regulatory practices will be developed.

*Urban drainage, *Storm runoff, Water pollution sources, Model studies, Snowmelt, Storm drains, Combined sewers, Drainage systems

Storm Water Management Model

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A003
GIVE STORMWATER POLLUTANTS THE SPIN,

Field, R. I., Moffa, P. E., and Karanik, J. M.

The American City and County, Vol. 91, No. 4, p 77-78, April, 1976. 2 fig, 1 tab.

A simple swirl regulator controls combined sewer overflows for a Syracuse residential complex, concentrating and retaining waste water solids while diverting excess storm water away from the treatment plant. During dry weather, when the flow is below the downstream capacity of the intercepter, a pump conveys the entire flow to the treatment plant. A flowmeter deactivates the pump when the flow exceeds this capacity. The waste water then flows by gravity through the swirl chamber, which diverts the storm water in excess of the treatment capacity. The system reduces settleable solids and floatables over a wide range of overflow rates. Biochemical oxygen demand (BOD) removals greater than 50% and grit reductions up to 90% are achieved. The pump used for dry weather flows would not be necessary in an ideal installation. During overflows, floatables are contained by the scum ring in the outer ring of the chamber and forced into a floatables trap. During subsequent dry weather, they are drawn down and removed.

*Sewerage, *Waste water treatment, *Overflow, *Combined sewers, Storm water, Storm runoff, Flow measurement, Flotation

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A004
HYDROLOGIC SYSTEMS ANALYSIS MODEL FOR GENERATING RUNOFF TIME SERIES (HIDROLOGIAI RENDSZERVIZSGALATI MODELL VIZHOZAMIDOSER ELOALLITASARA (II. RESZ),

Kontur, I.

Hidrologiai Kozlony, Vol. 56, No. 1, p 17-20, January, 1976. 4 ref.

Assuming that the catchment's runoff times are exponentially distributed, a flood wave is obtained which follows the gamma function. For its practical determination, two isochronous maps of the catchment must be prepared by assuming normal velocity for one and, for the other, the probable highest velocity. This method, which uses a probabilistic model, is less sensitive to erroneous velocity estimates than one based on conventional catchment characteristics. The velocity distribution function's shape is also obtained as a by-product. The construction can be simplified further by assuming a constant ratio of the shortest to the normal runoff times. A model also considering infiltration and evaporation regards both underground and surface runoff as stochastic processes; as a result, the seepage velocity is also a random variable. Infiltration, evaporation, and further precipitation flow are described by a random walk model. The model permits ready allowance for the reduced unit flood yield when the catchment area increases. The normal and maximum seepage velocities are parameters of the underground system. No spatial variation was assumed. The underground runoff hydrograph also assumes a gamma distribution shape. The model has been applied to determine a nonuniform slope section's runoff hydrograph. The model parameters were checked by analyzing the relationship of the stochastic model to the linear system. The combined approach to studying underground and surface runoff considers the hydrological processes' physical foundations more thoroughly than earlier models, and considers the water particles' potential paths using a random-walk formulation instead of using the hydrological processes.

*Runoff, *Hydrographs, *Model studies, Groundwater, Mathematical models, Infiltration, Evaporation

A005

THE INFLUENCE OF THE SURFACE RUNOFF OF HEAVY RAINS ON THE CALCULATION OF SEWERS (UBER DEN EINFLUSS DES FLACHENABFLUSSES DER STARKREGEN AUF DIE BERECHNUNG VON KANALISATIONEN),

Schulz, H.

Wasserwirtschaft-Wassertechnik, Vol. 26, No. 3, p 99-101, 1976. 5 fig, 2 ref.

A space-time coefficient method is described for the calculation of the influence of heavy rains on sewer dimensions. According to this method, the sewer system is dimensioned as a function of a retention coefficient, which is dependent of the sewer length per unit area and ultimately of the sewer length to flow rate ratio, and of a dynamic storage capacity, which is dependent of the orographic conditions. The usual reserves and safety margins are eliminated, which implies that the envisaged frequency of flood may actually occur. This frequency should be reduced accordingly for certain overflow in mixed sewer systems, retention basins or drainage canals in important urban and industrial agglomerations.

*Sewers, *Storm runoff, *Analytical techniques, *Combined sewers, *Drainage systems, Dimensioning, Retention, Flood frequency, Mathematical studies

Space-time coefficient method

A006

THE EFFECT OF VARIOUS DESIGNS OF RAIN CATCHING BASINS ON THE POLLUTION OF THE RECEIVING WATER AND THE ECONOMY OF THE SEWER SYSTEM (DIE AUSWIRKUNG DER VERSCHIEDENEN BAUARTEN VON REGENUBERLAUFBECKEN AUF DIE SCHMUTZBELASTUNG DES VORFLUTERS UND DIE WIRTSCHAFTLICHKEIT DES KANALNETZES),

Krauth, K.

Institut fuer Siedlungswasserbau und Wassergutewirtschaft der
Universitat Stuttgart,
Stuttgart, West Germany.

Berichte der Abwassertechnischen Vereinigung e.V., No. 28, p 583-591, 1976. 6 fig, 1 tab, 4 ref.

General considerations on the influence of rain catching basins on the pollution of recipients and on the economy of the mixed sewer system are presented. The efficiency of rainwater retention basins is apparent from the fact that the pollutant loads occurring during the initial phase of the rainwater runoff are multiples of the average load. Several basins should be linked in a by-pass system to prevent the discharge of runoff once retained in one basin into the recipient from the next one. Catchment basins are unable to retain the runoff during the later phase of many prolonged rain events. Basins of up to 500 cu m should be self-scavenging, and scavengers are necessary for larger units. For economic reasons, large areas should be subdivided into homogeneous zones of 20-40 ha each, with separate runoff retention basins in by-pass.

*Basins, *Rain water, *Combined sewers, *Runoff, Bypasses, Watersheds (basins), Rainfall, Design, Retention

A007
CONTRIBUTION TO THE STUDY OF STORM WATER IN URBAN ENVIRONMENT
(CONTRIBUTION A L'ETUDE DES EAUX DE RUISSELLEMENT EN MILIEU URBAIN),

Poustis, J., Martin, G., and Dubreuil, J. P.

Techniques et Sciences Municipales--L'Eau, Vol. 71, No. 4, p 179-181, April, 1976.
3 fig, 1 tab, 2 ref.

A study was made in an urban environment to assess the potential hazards of using drainage water for recreational purposes. Zinc and copper contents were low, but significant quantities of lead and hydrocarbons were found. Chemical oxygen demand (COD) is at a maximum after one hour of rain, and greater after a long dry spell, but pollution due to storm water remains small.

*Pollutant identification, *Storm water, *Cities, *Drainage water, *Urban drainage, *Recreation, Zinc, Copper, Chemical oxygen demand, Lead, Organic compounds

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A008
STORM WATER MANAGEMENT MODEL: DISSEMINATION AND USER ASSISTANCE,

Hagarman, J. A., Dressler, F. R. S.

University City Science Center,
Philadelphia, Pennsylvania.

May, 1975. 46 p, 23 fig, 13 tab, 10 ref, 1 append. Technical Report PB-242 544.

A program of dissemination and user assistance for the Environmental Protection Agency (EPA) Storm Water Management (SWMM) was developed and implemented. Services available to users included distribution of the SWMM program itself and technical assistance in problem delineation, data preparation, execution debugging, and output interpretation. All technical assistance is covered by an EPA grant; the only costs of this service are the actual costs of computing. The SWMM technology was introduced to a wide range of potential users: engineering and design firms, government agencies in Pennsylvania and New Jersey, planning boards, educational institutions in the Delaware Valley, and conservationists and environmentalists. The dissemination effort reached a wide geographic assortment of consulting engineers, but only a rather narrow geographic sampling of municipal planning groups. The model was applied to a combined sewer overflow problem in Binghamton, New York. The overflows were located and quantified, and the adaptability of SWMM was demonstrated when it was modified to allow for direct routing of sewer surcharges to the receiving water. SWMM was also used to study stormwater runoff problems in connection with a land use plan in the Stony Brook Basin near Princeton, New Jersey. Assisting users in defining problems, relating these to the SWMM, and outlining the capabilities and requirements of SWMM were necessary.

*Analytical techniques, *Water quality, *Mathematical models, *Waste treatment, *Water pollution, Rainfall, Erosion control, Surface runoff, Storm runoff

*Storm Water Management Model (SWMM)

A009

WATER QUALITY MANAGEMENT PLANNING FOR URBAN RUNOFF,

December, 1974. 214 p, 36 fig, 38 tab, 160 ref, 4 append. Technical Report PB-241 689.

Technical assistance is provided to state and local water quality management planners for identifying and characterizing urban runoff as a non-point source of water pollution without extensive data generation. Preliminary evaluation of cost effective abatement and control practices is also discussed. The analytical procedures are identified according to three levels, requiring increasingly more effort and yielding correspondingly higher degrees of accuracy. The characterization is limited to runoff from impervious surfaces, which is the predominant source of pollutants associated with urban stormwater. Analytical procedures to predict the quality, quantity, and rate of runoff from specified storm events are included. Examples illustrate these analytical methods and procedures. Runoff from sources such as urban irrigation and snowmelt is also included. General criteria for evaluating the water pollution potential of urban runoff, as well as methods for treatment, abatement, and ultimate disposal are discussed. Background information is provided, emphasizing recent studies.

*Waste water treatment, *Analytical techniques, *Water pollution, *Water quality, *Urban runoff, Storm runoff, Runoff forecasting, Snowmelt, Storms, Surface waters, Planning

Surface water runoff, Urban planning

A010

URBAN STORMWATER MANAGEMENT MODELING AND DECISION-MAKING,

Heaney, J. P., Huber, W. C., Sheikh, H., Medina, M. A., and
Doyle, J.

Florida University,
Gainesville,
Department of Environmental Engineering Sciences.

May, 1975. 185 p, 37 fig, 47 tab, 92 ref. Technical report PB-242 290.

The Environmental Protection Agency (EPA) Storm Water Management Model (SWMM) was tested, refined, and augmented to develop decision-making techniques for studying runoff problems. The refinements include incorporating a sediment prediction capability using the Universal Soil Loss Equation. Other refinements reflect recent developments such as swirl concentrators. The model was tested in Lancaster, Pennsylvania. Agreement between predicted and measured hydrographs and pollutographs was only fair, due to the very limited and somewhat questionable quantity and quality verification data available. Quality predictions and the limited measured data available were reasonably close for the Conestoga River, the receiving waterway. The refined and augmented model showed an improved capability to describe the various processes. The decision-making model examines stormwater management in the general context of water resources management. It indicates that urbanization results in significantly higher peak flows and substantially increased control costs. Interrelationships with flood control and drainage, street and parking lot design, and air pollution are included. Impervious areas associated with the automobile appear to be the most important source of stormwater problems. More efficient use of paved areas appears to reduce the problem. An optimization procedure for control strategies uses linear programming techniques and procedures from cooperative N-person game theory. The SWMM was also applied to preliminary hydraulic design of sewer systems. The runoff portion provided a more accurate inlet hydrograph. The transport portion analyzed the hydraulics of flow through sewers, including a routine that checks for surcharging.

A011

NITROGEN AVAILABILITY IN URBAN RUNOFF,

Cowen, W. F., Sirisinha, K., and Lee, G. F.

Wisconsin University,
Madison,
Water Chemistry Program.

Journal Water Pollution Control Federation, Vol. 48, No. 2, p 339-345, February, 1976. 4 fig, 16 ref.

A series of mineralization tests were performed to study the reactions in which organic nitrogen is converted to ammonia nitrogen, which is converted to nitrite nitrogen, which is converted to nitrate nitrogen in urban runoff under the influence of the bacteria in the runoff. Grab samples of urban runoff were collected from street gutters and open storm sewers in a low density residential area, a medium density area, and a university campus in Madison, Wisconsin. The samples were chemically analyzed for ammonia nitrogen, nitrate nitrogen, total Kjeldahl nitrogen (TKN), and soluble Kjeldahl nitrogen (SKN). Nitrite nitrogen concentrations were assumed to be negligible. Runoff samples were then incubated in darkness for 82 to 100 days at 21 C and analyzed for ammonia nitrogen and nitrate nitrogen at intervals. The concentration of algal-available nitrogen was computed and the TKN and SKN values determined. The mineralized waters contained from 57% to 82% of total nitrogen as algal-available nitrogen, with an average of 70%. Since algal-available nitrogen in the fresh runoff samples ranged from 4 to 66% of total nitrogen, the influence of bacterial mineralization on the release of inorganic nitrogen from the runoff to the waters receiving the runoff is readily apparent. Gross underestimates of available total nitrogen could result if only the inorganic nitrogen data from chemical analyses of fresh runoff are considered. The mineralization of organic nitrogen forms should be considered in any estimates of the true, biologically important nitrogen loadings from urban runoff.

*Pollutant identification, *Analytical techniques, *Nitrogen, *Urban runoff, *Chemical reactions, Organic compounds, Ammonia, Nitrites, Nitrates, Bacteria

Mineralization

A012

QUANTITATIVE ASSESSMENT OF CHANGES IN URBAN RUNOFF,

Cech, I., and Assaf, K.

Texas University Health Science Center,
Houston,
School of Public Health.

Journal of the Irrigation and Drainage Division-ASCE, Vol. 102, No. IR1, p 119-125, March, 1976. 4 fig, 12 ref, 1 append.

Trend surface analysis of distribution of storm runoff was used to detect and quantitatively assess the magnitude of human-induced changes in flood regimes in part of the Texas Gulf Coast. This procedure incorporates frequency analysis and two- and three-dimensional synographic computer mapping. Comparison of the natural geographic tendency in runoff distribution typical for the area and the runoff pattern induced by urbanization leaves little doubt that urban development has had a profound effect on the runoff regimes. Flood events of various frequencies of recurrence in the Galveston Bay area were spatially analyzed; the highest peak flow occurs in regions of most intense urbanization and industrialization. Considering the relative simplicity of local topography and the comparative homogeneity of other natural physiographic characteristics, such an abrupt increase in flow must result from human-induced changes. The differences between urban and non-urban runoff were 3 to 5 times the background magnitude for the Houston area, and 2 to 2.5 times in the comparatively smaller Beaumont area. This range of differences could be used as a guide in planning development in coastal areas that are now primarily rural.

*Analytical techniques, *Urban runoff, *Analysis, *Storm runoff, *Flood flow, Texas, Gulf Coastal Plain, Coasts, Flood peak

*Trend surface analysis

A013
URBAN RUNOFF AND COMBINED SEWER OVERFLOW,

Field, R., Curtis, J., and Bowden, R.

Environmental Protection Agency,
Edison, New Jersey,
Wastewater Research Division.

Journal Water Pollution Control Federation, Vol. 48, No. 6, p 1191-1206, June, 1976.
156 ref.

A literature review of documents dealing with urban runoff and combined sewer overflow is presented. General topics covered include: urban runoff quality, receiving water impacts, the monitoring of urban runoff pollutants, water quality control planning, runoff pollution modeling, flow regulation and control, and legislation for controlling urban drainage. Specific subjects discussed under the above general headings include: the effects of suburban development on runoff, a comparison of urban, watershed pollutant levels with those in forested watersheds, the use of coliform and orthophosphate levels as indicators of stormwater impact, the suitability of automatic sampling and monitoring equipment for storm and combined sewer systems, required elements of a master plan for water quality control of combined sewer systems, data required for verifying stormwater models, design procedures for calculating settleable solids removal efficiency for combined sewer overflow regulators, and a model urban drainage ordinance.

*Urban runoff, *Urban drainage, *Overflow, *Sewers, *Combined sewers, *Flow control, Indicators, Coliforms, Phosphates, Land use, Monitoring, Planning, Water quality control, Storm water, Storm runoff, Sampling, Legislation, Legal aspects, Model studies

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A014
URBAN STORMWATER RUNOFF: DETERMINATION OF VOLUMES AND FLOWRATES,

Chow, V. T., and Yen, B. C.

University of Illinois,
Urbana-Champaign,
Department of Civil Engineering.

May, 1976. 252 p, 69 fig, 13 tab, 66 ref, 4 append. Technical Report
EPA-600/2-76-116.

A depth-duration-frequency analysis method was developed for rainstorms with short return period (high frequency) for urban storm water runoff management and control purposes. The Illinois Urban Storm Runoff method is described, including the development of the model to couple with the Illinois Storm Sewer System Simulation Model and the formulation of a non-reactive water quality model to compute the pollutant concentrations of urban runoff. Selected runoff prediction methods, the rational method, unit hydrograph method, Chicago hydrograph method, British Transport and Road Research Laboratory method, Environmental Protection Agency (EPA) Storm Water Management Model, and the Illinois Urban Storm Runoff method, are evaluated using the recorded hydrographs of four rainstorms in the Oakdale Avenue Drainage Basin in Chicago. The methods are applied to compute the predicted runoff hydrographs, and the results compared with the recorded hydrographs. The most suitable method depends on the objective and accuracy required. The rational method is often satisfactory for a quick, simple approximation of peak runoff rate; for a project involving high accuracy and details of runoff distribution, the Illinois Urban Storm Runoff method is suitable. The EPA Storm Water Management Model may be the alternative if the downstream backwater effects are unimportant. When the unit hydrograph for the drainage area is unavailable, the Transport and Road Research Laboratory method appears preferable to the Chicago and University of Cincinnati methods in most cases.

A015

URBAN RUNOFF POLLUTION CONTROL PROGRAM OVERVIEW: FY'76,

Field, R., Tafuri, A. N., and Masters, H.

Municipal Environmental Research Laboratory,
Cincinnati, Ohio,
Storm and Combined Sewer Section.

March, 1976. 67 p, 15 fig, 11 tab. Technical Report EPA-600/2-76-095.

The basic technical and administrative problems associated with urban runoff and the approach of the Environmental Protection Agency's (EPA) research and development program to combat these problems are reviewed. Information on flood control, erosion control and the basic pollutional problems created by wet weather flows is presented. Nationwide cost requirements for abating urban runoff pollution and available abatement technology are discussed. Of overlying importance, program direction and desired goals are cited with intent towards a truer concept of solution methodology involving receiving stream impact analyses. Details of technologic advancements resulting from some 150 research and development projects are summarized. Both non-structural and structural control are included. The problem is divided into the categories of problem definition, user assistance tools, land management, collection system control, storage, treatment, sludge/solids, integrated systems, and technical assistance/technology transfer. General cost comparisons are made for urban runoff pollution control/treatment. A cost-effective solution for urban runoff pollution control by in-line storage in Seattle, Washington, and a simplified hypothetical plan for wet-weather flow pollution abatement for the Des Moines, Iowa, area are given.

*Waste water treatment, *Waste treatment, *Sewage treatment, *Runoff, *Waste water (pollution), Water pollution control, Sewage, Water quality, Hydrology, Combined sewers

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A016

URBAN STORMWATER DETENTION AND FLOW ATTENUATION,

Poertner, H. G.

Public Works, Vol. 107, No. 8, p 83-85, August, 1976.

Methods for achieving stormwater detention and flow attenuation in urban areas are discussed, with particular emphasis on detention ponds on earth surfaces, detention of rainfall on parking lots, and rainfall detention on rooftops. The following criteria for designing detention facilities are discussed: the prevention of excess stormwater buildup in habitable areas, the provision of a positive outlet for discharge of inflows when storage capacity is exceeded, the construction of sufficient slopes for detention areas, the proper location of the deeper portions of storage areas, an evaluation of runoff that is likely to enter the storage site from upstream areas, the provision for uniform regulation of release flow rates, the planning of storage areas for more than one purpose, and the calculation of storage volume requirements. The development of storage ponds into recreational facilities is also discussed.

*Urban runoff, *Storm water, *Detention reservoirs, *Cities, *Flow control, Rain, Design criteria, Recreation facilities, Surface waters

A017

PHYSICAL-CHEMICAL TREATMENT IMPROVES IRAN'S URBAN RUNOFF,

Samar, P., Sarai, M., Razeghi, N., Jamshidnia, G.,
and Hakimipour, M.

Teheran University,
Teheran, Iran,
Department of Environmental Health.

Water and Sewage Works, Vol. 123, No. 8, p 77-79, August, 1976. 4 fig, 2 tab,
8 ref.

Environmental studies in Iran have revealed that a physical-chemical process consisting of coagulation, flocculation, sedimentation, and carbon adsorption is effective in treating urban land runoff. A system employing coagulation with alum, sedimentation, and adsorption with powdered activated carbon yielded average removal efficiencies of 97, 85, and 100% for turbidity, chemical oxygen demand, and lead, respectively. By comparing removal efficiencies in various stages of the treatment process, it was established that turbidity, chemical oxygen demand, and lead are mostly in the settleable and suspended solid forms. Consequently, coagulation, flocculation, and sedimentation result in high removals for these parameters. The optimum dosage of powdered activated carbon was chosen according to the adsorption efficiency of carbon for dissolved organics and averaged 58 milligrams/liter.

*Urban runoff, *Waste water treatment, *Coagulation, *Adsorption, *Flocculation, *Sedimentation, Turbidity, Chemical oxygen demand, Lead, Heavy metals, Suspended solids, Separation techniques, Efficiencies, Performance, Activated carbon

Iran

B001
DIMENSIONING OF UNDERGROUND SEWER PIPELINES MADE OF PLASTIC TUBES (Raschet podzemnykh kanalizatsionnykh truboprovodov iz polimernykh trub),

Sladkov, A. V., and Otstavnov, A. A.

Plasticheskie Massy, No. 10, p 65-67, 1975. 2 fig, 3 ref.

Nomograms for the dimensioning of plastic tubes for underground sewer systems and for the determination of wall thicknesses and maximum depth are presented. These are applicable to sewer pipes made of high-density and low-density polyethylene, non-plasticized PVC, and polypropylene for diameters of 160-630 mm. Compared with sewer pipes made of asbestos cement and other conventional ceramic materials, plastic pipes require reduced slope (by 35-50%), and have higher throughput capacity (by about 30%) at the same free cross-section. This results in a reduction of the required earthworks.

*Sewerage, *Sewers, *Pipelines, Pipes, Plastic pipes

*Pipe sizes, *Nomograms

B002
GIANT MOLE TO DIG SANITARY DISTRICT TUNNELS,

Midwest Engineer, Vol. 28, No. 6, p 4-7, March, 1976.

An extensive project, the Tunnel and Reservoir Plan of the Metropolitan Sanitary District of Greater Chicago (MSDGC), has been designed to control the flow of sewage during wet weather periods from a metropolitan area of the city served by combined sewers. During storms, these sewers receive 10 times the dry weather flow or more. While common practice was to allow the peak flows to be diverted to rivers, in Chicago the water quality of the Chicago River, the Des Plaines River and the Calumet River Systems are seriously impaired by this practice. In order to control water pollution to these areas and to improve the quality of Lake Michigan waters, the MSDGC plans to construct over 125 miles of large diameter tunnels in rock beneath the waterways of metropolitan Chicago, at depths between 150 and 300 feet. During wet weather, combined sewer flow will be diverted to the tunnels and stored in holding reservoirs under aeration. Between storms, during dry weather, the captured flow will be pumped to treatment facilities, with increased pumping during periods when flow is normally low. Tunnel diameters will be between 15 and 35 feet. A large boring machine or "mole" has been used at three pilot excavation projects and will be applied to the new plan in order to quickly and economically prepare the tunnels.

*Tunnels, *Sewers, *Waste water treatment, *Flow, Lake Michigan, Water pollution control, Excavation, Costs

Combined sewers, Chicago, Pilot studies

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B003
FIBERGLASS FIGHTS SO3 ATTACK ON SEWERS,

Water and Sewage Works, Vol. 123, No. 2, p 60-61, February, 1976.

Three types of manhole-wetwell construction are used in Hillsborough County, Florida: reinforced concrete with 20 mil protective coating of coal tar epoxy for both sides; brick with acid-proof mortar; and the more innovative fiberglass reinforced plastic. Fiberglass products, while priced higher than competitive materials, have been designed to last for longer periods. Fiberglass is especially useful in combatting severe hydrogen sulfide corrosion. The Hillsborough County has installed fiberglass products in a residential area sewer project, operating since December 1975. Submersible wetwell units were chosen and contractors reported faster and easier installation for these types of manholes. An important feature of the fiberglass manholes and wetwells was their toughness and strength. Other area projects incorporating fiberglass included the use of manhole liners that are straight sections of 42 inch inner diameter fiberglass-reinforced plastic pipe to repair deteriorated brick manholes.

*Sewers, *Construction materials, *Manholes, Plastics, Corrosion control

Fiberglass reinforced plastic

B004
PENNSYLVANIA SEWER PLACED IN CROWDED DITCH,

Engineering News-Record, Vol. 196, No. 10, p 40, March 4, 1976. 1 tab.

The contract for installing 3730 linear feet of concrete interceptor sewer pipe along the Little Juniata River, near Altoona, Pennsylvania, has been awarded to Ernest P. Renda, Incorporated. The firm plans to place 48-inch diameter pipe in lengths of up to twenty feet along a 400 foot-wide ditch parallel to the river. The completed line will be within 30 feet of the shore line. At one point of the sewer, a 430 foot-long section will be installed 12 feet under the riverbed for a crossing. The estimated cost of the project is $1,123,000.

*Sewers, *Construction costs, *Concrete pipes, *Installation, *Interceptor sewers, Pennsylvania, Costs, Rivers, Engineering structures

B005
STORM SEWER PIPE JOINTS TIGHT AFTER TEN YEARS,

Domingue, E.

Domingue, Szabo and Associates, Incorporated,
Lafayette, Louisiana.

Public Works, Vol. 107, No. 3, p 59, March, 1976.

A systematic testing and evaluation program was instituted by the Louisiana Department of Highways involving materials used for the construction of storm sewer pipes. Selected for inspection in 1973 was a 5700 foot storm sewer system in Lafayette which had been constructed in 1964 and 1965. The sewer pipe had been designed using a preformed, flexible plastic gasket in extruded "rope" form, packaged between protective paper wrappers, sized in cross section to pipe diameter. The system had been designed to provide a drainage system which would handle runoff and remain watertight for as long as technologically possible. The 1973 inspection included the collection of samples for laboratory testing. The Ram-Nek flexible plastic gasket material in the pipeline was found to show no sign of deterioration, loss of flexibility or loss of adhesion to the concrete joint surfaces after a period of nearly ten years. Thus, it is planned to continue using this method and material for sealing reinforced concrete pipe in future installations.

*Joints (connections), *Pipes, *Sewers, *Storm runoff, Construction materials, Plastics, Louisiana, Evaluation, Laboratory tests

Storm sewers

B006
WATER CONTROL SOLVES TOUGH SEWER PROBLEM,

Highway and Heavy Construction, Vol. 119, No. 2, p 34-35, 38, February, 1976. 2 fig.

A complex sewer project in Houston, Texas, involved three methods of controlling flood water drainage and wet subsurface sands. The job consisted of tunnels 78 ft, 168 ft, and 145 ft long in the state right-of-way as part of Houston's Almeda Road Sewer Outfall Project. In the construction of the 145 ft tunnel, the existence of a 10 by 6 ft concrete box culvert nine feet above the proposed tunnel required the control of surface runoff. Flow had to be diverted over and around the work shaft to prevent flooding, and a dirt cofferdam was constructed to permit surface runoff to bypass the tunnel area. In addition, the concrete box culvert was intersected by a 24 inch storm sewer on the east and a 30 inch storm sewer on the west. Steel pipe had to be placed through the culvert to the cofferdam and the two storm sewers were connected during the tunnel construction. Other problems involved the wet subsurface soil conditions, which were alleviated with the installation of an educator system of 21 wellpoints at each end of the tunnel. With extensive planning for both the runoff control and the dewatering system, the Almeda Road Storm Sewer Outfall Project was completed with little disturbance to the traffic flow on the state and U.S. highways under which the system was installed.

*Sewers, *Flood control, *Construction, *Outfall sewers, Texas, Drainage systems, Tunnels, Storm runoff, Installation

B007
PROBLEM: LOW HEADROOM, SOLUTION: PIPE ARCH,

Water and Sewage Works, Vol. 123, No. 3, p 100, March, 1976. 5 fig.

The moving of the Marshfield clinic, (Marshfield, Wisconsin), presented a sewerage problem in that the farmland to which the clinic was moving was flat, contained a small stream and would not be easy to drain. A main line 1,267 foot storm sewer would have a drop of only two feet from an initial four foot depth and would have to carry 72,000 gpm. Since conventional round pipe would have been sticking out of the ground, a corrugated steel pipe arch shape was selected. The storm sewer contains 730 feet of 65 by 40 inch corrugated steel pipe arch; the rest of the sewer is 72 by 44 inch pipe. The soil is sandy stony plastic clay which does not present any corrosion problems. The choice of corrugated steel pipe was economical and is considered as the permanent pipe in this location. As of 1975, Marshfield had 162,917 feet of storm sewer, 27,413 feet of which were corrugated steel.

*Sewers, *Pipelines, *Steel pipes, Construction materials, Storm sewers

Corrugated steel pipe arch

B008
SEWER CLEANER FLUSHES OUT ACIDS,

Eadens, C.

Water and Sewage Works, Vol. 123, No. 3, p 65, March, 1976. 2 fig.

A truck-mounted high velocity hydraulic sewer cleaner was used to clean inactive reuse water and acid sewer lines around gun powder production facilities at the Charlestown, Indiana, Army Ammunition Depot. During full-scale powder production at the height of the Vietnam War, these lines had been used as catch-alls for spills and leaks from the acid transmission lines used in the manufacturing. Acid built-up over the years had corroded through the pipes and concrete casings and had begun to penetrate adjacent clay pipe water reuse lines which fed the powder-producing equipment. In addition to removing a 34-year accumulation of dirt, grease, brick and tile, the cleaning had to be 100 percent effective so that the damaged pipe could be efficiently repaired. The 8500 feet of line was cleaned in only 50 working days. Conventional cleaning techniques would have required three or four times as much time, and would have been less efficient. The procedure required the operator to position the street-level sewer cleaning equipment at the manhole downstream with the hose reel above the opening. The high pressure water jets from a special high pressure hose flushed the sewer clean, forcing the debris down the line into the manhole. After the sewer was completely cleaned, a closed circuit television camera was pulled through the sewer, beaming photos of the inside of the line to a video monitor. A chemical grouting packer was used in conjunction with the TV inspection to repair faulty joints and leaks.

*Sewers, *Cleaning, Pieplines, Repairing

High velocity hydraulic sewer cleaning, Television inspection

B009
BELLEVILLE PLANT USES 15 PUMPS IN FOUR STATIONS,

Water and Pollution Control, Vol. 114, No. 3, p 26-27, March, 1976.

The facilities of Belleville, Ontario, for water pollution control serve a population of only 30,000. It has a large pumping capacity, however, with 15 pumps transporting sewage to the treatment plant and transferring it within the plant. Three of the four pumping stations are used in bringing sewage to the treatment plant. One of these has a constant-speed sewage pump and a centrifugal pump, both driven by electric motors. Another pumping station contains a constant-speed centrifugal pump, a centrifugal pump with variable speed, and a dual-driven pump, with individual electric motors. The third pumping station transporting sewage to the plant, located at the plant, also has three pumps: a constant-speed centrifugal pump, a variable-speed centrifugal pump, and a third centrifugal sewage pump. The plant itself contains two centrifugal pumps for sludge transfer, with individual motors and a centrifugal pump for sludge recirculating, driven by its own motor. The digester control building has a water pumping unit and sump pump, and there are two timer-controlled raw sludge pumps in the grit building.

*Pumping plants, *Pumps, *Pumping, *Sewers, Treatment facilities, Centrifugal pumps, Hydraulic equipment, Waste water treatment

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B010
PIPELAYING 'HORSE' PREASSEMBLES AND HELPS INSTALL OCEAN OUTFALL,

Water and Sewage Works, Vol. 123, No. 2, p 50-51, February, 1976.

A pipelaying horse that can preassemble pipe joints and install the preassembled sections underwater is being used to construct the ocean sewer outfall for Santa Barbara, California. The project involves installing 8,726 ft of reinforced concrete pipe, in lengths of 24 ft. Pieces of pipe are stockpiled on pipe racks onsite to provide backup and ease problems associated with unloading incoming pipe. Construction of the ocean sewer outfall is expected to cost over $4.5 million. Sheeting for the project was manufactured in Europe by the British Steel Corporation. Two types of ballast rock will be used. A crane barge is used with the pipelaying horse. A rock sled is towed along the pipe by the crane barge for ballasting the pipe. A walking platform is used instead of the crane barge for the portion of the work near shore. The platform will first install a sheetpile cofferdam. It will then lay pipe in the same way as the horse. The walking platform makes it unnecessary to construct a long trestle near the shore. A temporary rail system on top of the sheetpiling will carry pipe and rock near the shore.

*Pipelines, *Installation, *Pipes, *Joints (connections), *Concrete pipes, California, Sewers, Outfall sewers, Oceans

B011

POLYETHYLENE PIPE TACKLES DIFFICULT SEWER REPAIR JOB,

Water and Sewage Works, Vol. 123, No. 2, p 48, February, 1976.

A difficult sewer repair problem at La Mesa, California, was completed by the insertion of long, fused lengths of polyethylene pipe. A 55-year-old six-inch concrete sewer located in an area of beautifully landscaped homes on a steep, rocky hillside was badly in need of replacement due to heavy infiltration and exfiltration and stubborn root penetration which was causing stoppages. The first step was to inspect the line by video camera, recording the interior. Polyethylene pipe (OD 5.375 inches) was pulled through the pipe in 38-foot sections. As each section was lined, lateral connections were made. The project required five weeks to complete 3000 feet of relining; service was interrupted only when lateral connections were being effected. The final cost was much less than that of direct replacement.

*Sewers, *Repairing, *Plastic pipes, Installation

Slip-lining

B012

SEWER INSPECTION: CHECKING IT OUT,

Fielding, L.

Water and Wastes Engineering, Vol. 13, No. 4, p 16, April, 1976.

Trends and commonly used techniques for sewer inspection and maintenance are discussed. Visual on-site inspection is the most commonly used inspection method. Closed circuit television cameras are becoming more commonly used. The sewers in Sparks, Nevada, are inspected visually in manholes and internally by a closed circuit television system. The visual inspection is performed weekly, while television inspection is performed on a time available basis. Rodders, vacuum units, electric eels, and buckets and brushes are all used to varying degrees to clean sewers. Tree roots are the most common problem found in routine maintenance. Slip-liner technology for the replacement of deteriorated mains is being considered by Oklahoma City. The frequency of inspection and maintenance depends on available manpower and time. Money is another important factor. At Sparks, Nevada, about 5% of the system is inspected visually weekly, 10% is cleaned every three months, 5% is cleaned every six months, 5% is cleaned every year, 15% is cleaned every two years, 20% is cleaned every five years, and about 40% is not cleaned. Approximately 48% of the utility budget of Sparks is spent on sewer inspection and maintenance.

*Sewers, *Maintenance, *Cleaning, Repairing, Inspection, Equipment, Maintenance costs

Television inspection

B013

HOW MANY SEWER LEAKS CAN YOU AFFORD?,

Diehl, D. S.

Roy F. Weston, Incorporated,
Houston, Texas.

The American City and County, Vol. 91, No. 4, p 55-57, April, 1976.

The basic problems caused by infiltration/inflow (i/i) in a sewer system are: excessive maintenance, discharge of poorly treated waste water during periods of high groundwater or rainfall, backups and overflows of raw sewage, surchaged sewer lines which prevent the use of plumbing facilities in low-lying areas; and the overloading of treatment plants, pump stations and interceptors. Sewer systems are eligible for federally-funded sewerage construction grants, provided an infiltration/inflow analysis demonstrates that it would be more economical to repair the sewers than to treat the i/i. In order to estimate the magnitude of i/i to which a system is subject, the peak, average and minimum flows during dry and wet weather for major sections must be determined. Three flow measuring devices generally used are Cipolletti weirs with liquid level recorders, event recorders, and bypass times. In evaluating the system, each manhole must be physically inspected on a drainage basin by drainage basin basis. In some systems, it is cost effective to smoke test the manhole and lines leading to it. Other steps in the evaluation include simulation of rainfall and quantification of the rate of infiltration or inflow from a particular source or suspected manhole or sewer section. Those lines with obvious potential for "excessive" i/i should be cleaned and internally inspected with closed circuit TV. A final evaluation report must show all i/i sources as well as justification and a method for rehabilitation and repair of specific sections.

*Sewers, *Sewerage, *Pipelines, *Infiltration, *Inflow, *Repairing, Measurement, Instrumentation, Drainage, Rainfall

Sewerage construction grants, Infiltration/inflow

B014

POLYETHYLENE PIPE INSERTION REHABILITATES OLD SEWERS,

Prefer, E. H.

Water and Sewage Works, Vol. 123, No. 4, p 92-94, April, 1976.

Sewers can be rehabilitated with less cost and disruption by inserting a new polyethylene pipe inside the old sewer pipe than by replacing the whole pipeline. The existing sewer line must be inspected before inserting new pipe; TV or other methods may be used for the inspection. Lengths of polyethylene pipe are joined by heat fusion, producing a joint as strong as the pipe itself. The new pipe is inserted by pulling it into the old pipe with a cable. When shallow house service lines are connected to deep sewers by vertical risers, an expandable connector can be inserted through the top of the riser. When excavation down to the connection spot is required, fusion saddles or, when conditions are wet, tapping saddles may be used. After the houses are connected, the annular space between the old and new sewer pipes is sealed. Such a renewal project was carried out in Freeport, New York, where many of the sewers were badly deteriorated and one section had caved in. The initial insertion involved lining a 565-ft length of lightly deteriorated 8-in. pipe. The sewer section that had caved in was replaced with clay pipe, but the parallel section on the other side of the street was lined with polyethylene pipe. No obstructions were encountered in lining the first section, but the second section, which had not been inspected immediately before insertion, became jammed with material flaking off the original pipe. The re-lining and reconnection were nevertheless completed in 5 days, at a savings of 90% as compared to the replacement of clay pipe on the other side of the street.

*Sewers, *Pipelines, *Plastic pipes, *Inspection, Testing, Equipment, Repairing, Rehabilitation, Sewerage, Costs

*Polyethylene pipes, Relining

B015

COMPARING INFLOW AND INFILTRATION,

Lutz, J. J.

Charles Pool and Associates, Incorporated,
Ketchikan, Alaska.

Water and Sewage Works, Vol. 123, No. 5, p 68-69, May, 1976. 4 fig.

Both inflow and infiltration into sewer systems vary considerably, and the problem of comparing systems can be avoided by standardizing field measurements to a common denominator to adjust all measured inflow and infiltration inputs to their probable peak values. This approach was used in Ketchikan, Alaska, where brief, intense inflow and infiltration episodes occur. Hydrograph analysis was performed, using a graphical technique similar to that used for stream hydrograph analysis. The first step involves subtracting the sanitary sewage component as determined from a dry weather base flow period. The graphical separation of infiltration is accomplished by estimating 'straight line' patterns on semilogarithmic graph paper as is done in determining stream baseflow levels in hydrology applications. After a number of storms have been analyzed, it is possible to estimate the probable worst infiltration rate and to relate inflow to rainfall. Inflow and infiltration problems are standardized by expressing every individual problem as a percentage of the whole at the time of measurement and multiplying the percentage by anticipated peak inflow or infiltration. If the percentages add up to more than 100%, the hydrograph analysis obviously bears checking. Individual percentages adding up to less than 100% of the total infiltration/inflow problem quantify the magnitude of undiscovered problems. A computer program has been developed to perform the standardization arithmetic once hydrographs have been manually analyzed. There is a degree of judgment involved when splitting the hydrograph into components, and users are cautioned to watch for seasonal variations. These techniques demonstrate that it is possible to adapt cost-effective analysis to the complexities of infiltration/inflow behavior.

*Infiltration, *Inflow, *Sewers, *Hydrograph analysis, Analytical techniques, Hydrographs, Storm runoff, Computer programs, Cost-benefit analysis

Infiltration/inflow

B016

CLEVELAND MIXES METHODS IN SEWER CONSTRUCTION,

Water and Sewage Works, Vol. 123, No. 5, p 90-91, May, 1976. 2 fig.

The Northwest Interceptor Sewer, one of five to be constructed in the Cleveland Regional Sewer District, is currently under construction and will divert stormflow in times of heavy rainfall. A combination of tunneling techniques are being used, because the sewer extends through several miles of mixed soil composition. A 4,200-ft-long open cut is also being used. For one section, an electrically powered machine with a 6 ft long blade cut the blue clay soil; than circular steel ribs were inserted. In areas where earth composition is shale, mining machines are being used. Various means are also being used to support the tunnels. Laser beam guidance systems have been used to keep the tunnel on line and grade.

*Interceptor sewers, *Tunnels, *Tunneling, *Excavation, *Sewers, *Tunneling machines, Soil types, Diversion structures, Storm water, Clays, Shales

B015
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*Infiltration, *Inflow, *Sewers, *Hydrograph analysis, Analytical techniques, Hydrographs, Storm runoff, Computer programs, Cost-benefit analysis

Infiltration/inflow

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*Interceptor sewers, *Tunnels, *Tunneling, *Excavation, *Sewers, *Tunneling machines, Soil types, Diversion structures, Storm water, Clays, Shales

B017
UNDERLAKE SEWER SPURS RESORT DEVELOPMENT,

McDonald, N., and Goodnow, W.

Burns and McDonnel,
Kansas City, Missouri.

Water and Wastes Engineering, Vol. 13, No. 5, p 70, 72, May, 1976. 1 fig.

An interceptor and waste water treatment plant project for the 25-square-mile Middle Big Creek watershed located south of Lee's Summit, Missouri is described. Sub-aqueous interceptors extend through three lake areas and are designed to provide gravity sewer service to the lakes' frontal development and eliminate the need for expensive lift station and force main systems around lake perimeters. The interceptor construction is designed to provide sewer service to a projected ultimate population of 78,000. The sub-aqueous pipe through the lakes is either ductile iron or prestressed steel-cylinder concrete pipe with supplemental interior coatings for corrosion and erosion protection. The pipeline is buried beneath the lake and pressure tested at heads greater than the lake's flood pool elevations to insure that lake water does not leak into the sewer. A 2 million gallon/day treatment plant is also scheduled for construction and will include a 2000 gallon/minute lift station, two 10-foot-deep aeration basins totaling 13.26 surface acres, a chlorine contact chamber, a standby power generator, and a blower building containing all controls and aeration compressor equipment. The interceptor and treatment plant project is funded by a 75% Environmental Protection Agency grant, 15% state grant, and 10% local share.

*Sewers, *Waste water treatment, *Treatment facilities, *Interceptor sewers, *Sewerage, *Subsurface drainage, Sanitary engineering, Materials, Engineering structures, Conduits, Lakes

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B018
HYDRAULIC JUMP IN CIRCULAR SEWERS,

Paintal, A. S.

Greater Chicago Metropolitan Sanitary District,
Chicago, Illinois,
Sewer Design Section.

Water and Sewage Works, p R-216-R-217, April 30, 1976. 4 fig.

A graphical method for estimating hydraulic jump depths in circular sewers is presented. The method is developed by first writing an equation for applying the momentum principle to a hydraulic jump in a horizontal circular sewer. Equations are then developed which relate the pre-jump and post-jump depths to the flow rate and sewer size. A graphical representation of these equations is then used to estimate pre- or post-jump depth for a given flow depth and flow rate.

*Sewers, *Hydraulic jump, *Graphical methods, *Equations, *Graphical analysis, Fluid mechanics, Hydraulics, Flow, Flow rates, Waste water treatment, Sanitary engineering

B019
TOWN MAINTAINS SEWERS DESPITE 'SUGAR SAND',

Venable, J. H.

Water and Wastes Engineering, Vol. 15, No. 3, p 45, 48, May, 1976.

Measures taken by Bossier City, Louisiana to maintain over 100 miles of sewer line which is particularly susceptible to breakage as a result of the fact that the city is located atop a subterranean layer of quicksand-like material called sugar sand are described. The loose consistency of sugar sand causes sewer line shifts, resulting in breakage. The exclusive installation of polyvinyl chloride pipe on both repair and new line construction was initiated to reduce problems associated with susceptibility to shock and soil corrosion. The city handles its own repair jobs internally and owns such equipment as a truck-mounted flexible high-velocity pipe cleaning machine, two trailer-mounted standard city sets, and a sewerodder. Originally, the city planned to amortize the equipment purchases over 10 years but found that much of it has paid for itself in just 2.5 years. Owning the equipment has also resulted in more flexible and efficient handling of sewer line repairs.

*Sewers, *Quicksand, *Municipal wastes, *Repairing, *Maintenance, Equipment, Financing, Sanitary engineering, Geology, Polymers, Materials

Sugar sand, Polyvinyl chloride

B020
WATER POLLUTION THROUGH RAIN OVERFLOWS FROM MIXED SEWERS
(GEWASSERVERSCHMUTZUNG DURCH REGENUBERLAUFE AUS MISCHKANALISATIONEN),

Herik, A. G.

Berichte der Abwassertechnischen Vereinigung e.V., No. 28, p 529-549, 1976. 15 fig, 3 tab, 9 ref.

Experiments on water pollution through rainwater overflows from mixed sewers are described in connection with preliminary standards promulgated in the Netherlands. With a minimal water depth of 1.5 to 2.0 m in the recipient, a specific recipient surface of 4 sq m per inhabitant is required and is sufficient for the uptake of the rain overflow. The flow rate should be low enough to achieve settling rather than whirl-up of sludge by the storm runoff in the sewer. To minimize the sludge entrainment from the sewer system, the latter should be as short as possible, and straight pipes with steady slope and without changes in their cross-section should be used. After overflow, the water quality of the recipient is normalized in a relatively short time concerning the BOD load, oxygen content and the bacterial contamination, while the increased nitrate and phosphate contents may require the additional discharge of fresh water.

*Combined sewers, *Overflow, *Water levels, *Rain water, *Sewerage, Sewage sludge, Flow rates, Biochemical oxygen demand, Dissolved oxygen, Sewage bacteria, Nitrates, Phosphates

B021
FIVE PUMPS SALVAGE A QUEBEC SEWER JOB,

Hancock, N.

Engineering and Contract Record, Vol. 89, No. 5, p 34, May, 1976. 1 fig.

Five large pumps were used to bail out when a sudden January mild spell caused serious flooding of a storm sewer being installed in Chateauguay, Quebec. The route followed an S-curve from the town's principal highway where a 1.5 m storm drain and a 67.5 cm sanitary drain are buried. During construction, part of the 1.5 m drain was temporarily removed and the runoff transferred by two electric pumps into the 3 m diameter pipe being installed. These pumps were unable to contain the flooding resulting from the combination of the sudden thaw and heavy rain. Although three more pumps were added, almost 2 days were required to pump at least 8 m of water out of the trench. The crushed stone base for the pipe had to be re-laid after the water was removed. The depth of the trench was 9 m, and its width was 14 m at the top, narrowing to 5 m at the lowest point. The excavation was done in two stages, after which the bottom of the trench was levelled and the pipe installed. A bulldozer was used to scrape earth from underneath telephone cable crossings. These lines slowed progress, although they were clearly marked on the drawings. A crane was used to lower the pipe into the trench.

*Separated sewers, *Drains, *Pipes, *Storm drains, *Pumps, *Floods, *Melt water, Rain water, Storm runoff, Construction

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B022
SEWERS - RELINING VS REPLACEMENT,

Spry, R. J.

Water and Sewage Works, Reference number, p R-66, April 30, 1976.

Experience with two sewer relining projects in Grand Rapids, Michigan is reported. One project involved relining 305 ft of a 10-inch sewer with DuPont Aldyl Series D Polyethylene which was installed in 18-foot lengths using a butt weld. The cost for relining was about $54.50/ft as compared with an estimated $85.20/ft which would have been required for reconstruction. The other project involved the relining of 47 ft of an 8-inch sewer with polyvinyl chloride pipe. Relining rather than replacement of this section resulted in a cost savings of more than $3400. The use of the above materials for making house connections did not prove to be successful. Pipe manufacturers are continuing efforts to improve the technique for this purpose.

*Sewers, *Linings, *Polymers, *Maintenance, Plastic pipes, *Maintenance costs, Materials, Sewage treatment, Conduits, Engineering structures, Structures

Polyethylene, Polyvinyl chloride

B023
SEWERAGE SYSTEM MONITORING AND REMOTE CONTROL,

Watt, T. R., Skrentner, R. G., and Davanzo, A. C.

Detroit Metro Water Department,
Detroit, Michigan.

May, 1975, 183 p, 89 fig, 8 tab, 57 ref, 2 append. Technical Report PB-242 107.

Sewer system monitoring and remote control, including telemetering rain gauges, sewer level sensors, overflow sensors, and central data processing facilities, were applied to Detroit's combined sewer system to reduce overflow pollution. Remotely controlling waste water pump stations and certain key regulators allowed in-system storage during storms, when many larger sewers were not used to capacity. System monitoring and remote control significantly reduced the volume of combined sewer overflows and storm waste water pumping. Telemetered rainfall data allowed one to 3 hr advance warning, used to lower the system's hydraulic gradient, allowing the 'first flush' of storm water to be more thoroughly captured. In-system storage concepts prevented approximately six billion gallons of storm water from overflowing into receiving streams during the study period, not including the additional storage produced by pumpdown. Monitoring has made possible holding back flow from portions of the system for inspection or maintenance without causing overflows. In-system storage using existing sewers costs under $.02/gal, while retention basin storage costs about $.20/gal or more. Flushing combined sewers with dry weather flow following storage was effective and relatively inexpensive in preventing sewer deposits. Since only one of the gates at multi-gated outfalls is monitored, overflows may not be recorded if the unmonitored gates were open while the monitored gate was not. The regulator operators were very reliable; no major failures occurred. Time-pulse telemetering devices were sufficiently accurate and not severely affected by transmission line noise.

*Waste water treatment, *Sewage treatment, *Sewerage, *Combined sewers, *Remote control, Treatment facilities, Remote sensing, Telemetry, Routing, Overflow, Sampling, Interception, Cost comparisons, Monitoring, Data collections, Storage

Detroit (Mich)

B024
SMOKE TEST SEWERS TO FERRET OUT ILLEGAL INFLOW,

Foster, W. S.

American City and County, Vol. 91, No. 6, p 44, June, 1976.

The use of smoke tests to identify pathways for the infiltration and inflow of unwanted surface water into public sewer systems is discussed. Smoke tests can be performed on a single line of sewers connected by two manholes or two lines connected by three manholes if the total run is not excessive. In the former case, the smoke is injected through either manhole; in the latter case, it is introduced through the center manhole. In either case the line or lines must be blocked to confine the smoke. The smoke can be produced either by candles or bombs that generate zinc chloride mist or by dioctylphthalate aerosol. A small portable blower like the type many municipal maintenance crews customarily use is sufficient for introducing the smoke into the manhole. If smoke rises from downspouts or outside drains, this indicates illegal connections with the sewerage system. Smoke appearing at the ground surface indicates a break in the pipeline.

*Sewers, *Surface waters, *Smoke, *Inflow, *Analytical techniques, *Infiltration, Pipelines, Measurement, Manholes

Smoke tests

B025
AVERAGE RISE OF EPA PLANT, SEWER INDEXES SLOWS,

Engineering News Record, Vol. 196, No. 26, p 112, June 24, 1976. 3 tab.

Sewer and plant cost indexes compiled by the Federal Environmental Protection Agency (EPA) rose from 1% to nearly 3% during the second quarter of 1976. However, the average increase rate for the series of three indexes during this period dropped slightly below the average increase rate for the previous quarter. City indexes for hypothetical facilities were determined for 25 cities. The average for a five-mgd plant increased 1.1% from the first-quarter average; that for a fifty-mgd plant increased 1.8%, and that for complete urban sewer systems increased 2.9%. The increase rates dropped from a first quarter average of 2.7% for a 5-mgd plant and from 2.6% for a 50-mgd plant, but increased from 2% for the sewer system. The 5-mgd hypothetical plant includes a bar screen, grit chamber, primary clarification, conventional activated sludge, chlorination, gravity thickening and vacuum filtration. The 50-mgd plant includes these plus lime clarification and multimedia gravity filtration as well as multiple hearth incineration. Labor considerations in the cost index for the sewer system include common laborers, cement finishers, carpenters, and medium equipment operators. Fringe benefits are included in labor rates. Concrete is ready-mix; pipe is reinforced concrete 24 in. in diameter, lumber is lowest grade, and asphalt is assumed to be paving asphalt. Second-quarter averages for old sewage treatment plant and sewer construction cost indexes were 257.8 and 269.7, respectively, up 4.8% and 5.5% respectively, from June 1975.

*Waste water treatment, *Activated sludge, *Treatment facilities, *Sewers, *Cost trends, Federal government, Cities, Average costs

Cost indexes

B026
POLLUTIONAL ANALYSIS OF COMBINED SEWER SYSTEMS,

Lindholm, O. G.

Norwegian Institute for Water Research,
Blindern, Norway.

Journal of the Environmental Engineering Division-ASCE, Vol. 102, No. EE2, p 301-312, April, 1976. 9 fig, 1 tab, 29 ref, 1 append.

A sewer network model and a waste water treatment plant model were used to analyze pollutional loads from combined sewer systems. Factors considered include the setting of the storm overflows, the amount of pollution in the storm runoff, the size of the secondary clarifier in the waste water treatment plant, and the degree of treatment at the storm overflow. The amount of pollution in the storm runoff greatly influences the total biochemical oxygen demand (BOD) discharged from a combined sewer system. The total amount of pollution discharged from combined systems may be substantially reduced by retention basins. The performance of retention basins is strongly affected by optimum setting of storm overflows and matching sizes of secondary clarifiers. The optimum setting of storm overflows is important, and is strongly influenced by the detention time in the secondary clarifiers and in the retention basins. If the BOD content in the storm runoff is relatively low and a relatively high amount of BOD is removed in the storm overflows, installing a retention basin may have an adverse effect.

*Waste water treatment, *Analytical techniques, *Biochemical oxygen demand, *Treatment facilities, *Combined sewers, Networks, Model studies, Water pollution, Storm runoff

B027

RISK-SAFETY FACTOR RELATION FOR STORM SEWER DESIGN,

Yen, B. C., and Tang, W. H.

Illinois University,
Urbana-Champaign,
Civil Engineering Department.

Journal of the Environmental Engineering Division-ASCE, Vol. 102, No. EE2, p 509-516, April, 1976. 3 fig, 1 tab, 9 ref, 2 append.

A new method has been proposed for optimal design of diameters and slopes of pipes of storm sewer networks. The basic equations involved are introduced. The four parameters contributing to the uncertainty in the sewer capacity are evaluated. This uncertainty results from uncertainties in hydraulic radius, resistance coefficient, slope, and equation error. The uncertainty of rainfall intensity varies with the design return period and the duration of the rainfall and the location and size of the drainage basin. A 10-acre drainage basin at Urbana, Illinois is considered as an example. The uncertainties in runoff coefficient, area, and equation error must also be known to determine the uncertainty in design discharge. A risk-safety factor curve can be constructed by calculating corresponding risks and safety factors for various pipe sizes with other conditions unchanged, and repeating the procedure for a different duration. Different curves should be used for different locations, because spatial variations of rainfall and surface slope will cause the curves to vary.

*Sewers, *Design criteria, *Risks, *Safety factors, *Storm drains, *Network design, *Pipes, Slopes, Equations, Rainfall intensity, Watersheds (basins), Discharge (water), Curves

*Storm sewers, Pipe diameter, Sewer capacity

B028

EVALUATION OF THE REPORT ON INTERCEPTOR SEWERS AND SUBURBAN SPRAWL,

January, 1975. 43 p, 4 tab, 6 append. Technical Report PB-250 617.

An Environmental Protection Agency (EPA) study group evaluated the conclusions of the Urban Systems Research and Engineering, Incorporated (USR+E) report for the Council on Environmental Quality, INTERCEPTOR SEWERS AND SUBURBAN SPRAWL. The report, based on an analysis of 52 interceptor projects and case studies from the larger sample, concluded that the presence of Federally financed interceptor sewers encourages development, and their routing, sizing, and timing influence land use patterns. It also concludes that current procedures and standards for design, review, and financing of projects strongly encourage unnecessarily large interceptor projects and do not stimulate public participation or ensure careful assessment of potential adverse secondary impacts and recommends that EPA not provide Federal funds for excess capacity, re-evaluate interceptor staging of projects in rapidly growing areas, use realistic standards for estimating per capita flow, improve population forecasting techniques and review procedures, require coordination of environmental effects of interceptor induced land use, and increase public participation by publicizing community costs and benefits of interceptor induced growth. The EPA group's 74 project survey agreed that half the land served by interceptor projects is vacant, but much of this sewering was unavoidable. The EPA disagrees with limiting interceptor design life to 25 yr, because some projects are likely to be more cost effective with longer periods. EPA agrees that no arbitrary gpcd standards should be set; factors like combined sewers and high infiltration/inflow justified several seemingly excessive design flows. The EPA group agrees that population forecasting should be improved but finds the recommendation to limit financial aid to the portion of interceptors needed for current population inappropriate.

*Waste water treatment, *Analytical techniques, *Sewerage, *Flow rates, *Interceptor sewers, Projects, Land use, Land development, Design, Human population

Excess capacity

B029
KAMINISTIQUIA INTERCEPTOR SEWER COMPLETED IN
THUNDER BAY,

Water and Pollution Control, Vol. 114, No. 7, p 42, July, 1976.

Progress in a major sanitary trunk sewerage program for Thunder Bay, Ontario is described. A 14,000-foot Kaministiquia interceptor sewer tunnel was recently completed at a cost of $6.3 million. Mining operations on another part of the project, a 5800-foot Neebing/McIntyre interceptor, have also started and are averaging 450 ft a week. Work has also started on another portion of the interceptor, a 48 by 65-inch diameter tunnel approximately 9000 ft in length. The total construction cost for the interceptor is $8.9 million. The construction work follows a detailed report which established the most economical means of bringing all sanitary sewage to a common treatment facility.

*Sewers, *Interceptor sewers, *Conveyance structures, *Hydraulic structures, Construction, Costs, Canada, Sanitary engineering, Waste water treatment

Ontario (Canada), Sanitary sewers

B030
SEWER FORCE MAIN HELPS SOLVE POLLUTION PROBLEM,

Water and Sewage Works, Vol. 123, No. 7, p 48, July, 1976. 1 fig.

The use of a 48-inch prestressed sewer force main to help solve the pollution problem affecting a heavily used recreational area in Mobile, Alabama is described. The construction of the main is part of a plan to abandon an Eslava Creek treatment plant which discharges into the Dog River and pump to a McDuffie pollution control plant for effluent dispersal into the Mobile River. The force main which extends from a new Eslava Creek pumping station to the McDuffie pollution control plant includes 560 ft of 36-inch prestressed concrete pressure pipe and 26,400 ft of 48-inch prestressed pressure pipe. A blind cross at the McDuffie plant will permit future expansion of the line. A 1900-foot section of the 48-inch pipe was installed above ground on piers because of unstable soil conditions. Another section of the project called for 50 ft of tunneling under the Louisville and Nashville Railroad and 168 ft of tunneling under Interstate 10.

*Sewers, *Recreation facilities, *Conveyance structures, *Hydraulic structures, Construction, Materials, Pipelines, Alabama, Sewerage, Pipes, Concrete

B031
LARGE-DIAMETER CORRUGATED STEEL PIPE INTERS STORM SEWER FIELD,

Water and Pollution Control, Vol. 114, No. 7, p 14-15, July, 1976.

The installation of 11-foot diameter, fully-lined corrugated steel pipe storm sewers via tunnelled construction is described as part of the Indianapolis, Indiana storm relief sewer project. The galvanized steel pipe which consists of 3 by 1 inch corrugations and spiral lockseam construction is first interior sprayed with bituminous material plus additives of asbestos and mica as a tack coating. This assures adherence of the finish coat, a centrifugally-spun liner of asphalt. Finally, asphalt is sprayed onto the pipe exterior for added corrosion resistance. Because of its comparatively light weight, the pipe can be winched into preplanned position. An 18-foot section weighs 7300 pounds as compared to 30,800 pounds for a 6-foot section of concrete pipe. Use of the 11-foot diameter steel pipe instead of 13-foot concrete pipe reduces the overall tunnel size to 13 ft, resulting in a savings of more than $100,000 in construction costs for a 1200-foot section.

*Sewers, *Steel pipes, *Storm drains, *Conduits, *Materials, Conveyance structures, Hydraulic structures, Pipes, Costs, Construction, Indiana

Indianapolis (Ind)

B032
A RETROSPECTIVE ON THE STRUCTURAL STABILITY OF RCC SPUN
SEWER PIPES,

Chauhan, V. S.

Jamaican National Water Authority,
Kingston, West Indies.

Journal of the Institution of Engineers (India), Vol. 56, Pt. EN2, p 45-50, February, 1976. 6 fig, 2 tab, 6 ref.

The structural stability of non-pressure cement concrete spun sewer pipes is discussed, with particular emphasis on determining the safe laying depth of such pipes. The supporting strength of a particular pipe classification is shown to be a function of the distribution of the vertical load, bedding conditions, and the lateral pressure which acts on the sides of the pipe. Data on the safe depth of earth cover and overburden for various bedding conditions are tabulated according to pipe diameters ranging from 150-1800 mm. Methods for detecting and repairing structural deficiencies in spun sewer pipes are also briefly outlined.

*Sewers, *Pipelines, *Hydraulic structures, *Conduits, *Concrete pipes, *Structural stability, Repairing, Conveyance structures, Sanitary engineering, Materials

B033
PLANNING AND CONSTRUCTION OF BIRMINGHAM'S MAIN
OUTFALL SEWER,

King, M. V.

Metropolitan Borough of Wolverhampton,
Great Britain,
Department of Technical Services.

Chartered Municipal Engineer, Vol. 103, p 87-95, June, 1976. 5 fig, 4 tab, 2 ref.

The design and construction of a main outfall sewer for the city of Birmingham (Great Britain) is described. Design is based on conditions which will prevail after major redevelopment is completed in the area and accommodates a 5-year storm in the foul water system. Design involving the storm water system is for a 2-year interval storm. The setting of overflows is based on frequency of operation, with storm flows being evaluated for frequent storms. The route of the main outfall is designed to collect together as many sewers as possible for routing to the Minworth Sewage Works. The most difficult single problem encountered in the project involved connection to the Minworth carrier. Detailed maps of the city illustrate the location of the main outfall sewer, overflows, the Minworth carrier, and drainage patterns. Cost estimates for the construction of the drainage system are also presented.

*Sewers, *Waste water treatment, *Urban drainage, *Urban hydrology, Hydraulic structures, Conveyance structures, Costs, Construction, Design criteria

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B034
MAINE SEWER BID 39% BELOW ESTIMATE,

Engineering News Record, Vol. 197, No. 7, p 45, August 12, 1976.

The construction of a proposed interceptor sewer for the city of Portland, Maine is discussed. The new interceptor will replace an existing brick sewer that discharges raw sewage into the Fore River and into Casco Bay. Work on the project includes the installation of about 5500 ft of 48-inch diameter reinforced concrete interceptor pipe along Portland's Commercial Street which runs adjacent to the river and bay. The pipeline will be installed in open trenches. Additionally, a 4500-foot long and 36-inch in diameter prestressed concrete force main will be constructed to carry the sewage from the interceptor to a new treatment plant. Overflow and diversion structures also will be built. About 400 ft of the new pipeline will be encased in concrete in areas where the interceptor will run under a series of railroad crossings. The lowest bidder for construction of the project dropped 39% below the consulting engineer's $3.9 million estimate.

*Interceptor sewers, *Construction, *Hydraulic structures, *Pipelines, *Materials, Conveyance structures, Costs, Maine, Sewage, Municipal wastes

Portland (Me)

B035

SEWERING THE CITY OF NEW YORK,

Lang, M., Samowitz, C., Jethwani, M., and Novotny, F.

New York City Environmental Protection
Administration,
New York, New York.

Civil Engineering-ASCE, Vol. 46, No. 1, p 54-57, January, 1976. 2 fig, 1 tab.

Efforts to update New York City's sewage collection system are reviewed along with current financial constraints hindering further development. Between the years 1967 and 1972, a crash program to improve the sewer system resulted in increasing the sewer output to $60 million/year. An accelerated sewer construction program was conceived in 1972, comprising $1.5 billion over the next 10 years. The key concept of the program was to proceed on entire drainage areas rather than on the piecemeal production of individual laterals to appease complaints on a given block. Recent financial difficulties, however, have at least temporarily stalled the program, with only about $10 million in funding going for sewer repairs. A breakdown of the city's sewerage needs is tabulated by individual boroughs.

*Sewers, *Sewerage, *Hydraulic structures, *Costs, *Programs, New York, Conveyance structures, Economics

New York City

B036

INSTITUTIONAL PROBLEMS OF THE SMALL TREATMENT PLANT,

Martin, E. J., DuBois, R., and Bernard, H.

Environmental Quality Systems, Incorporated,
Rockville, Maryland.

In: Proceedings of the 1975 National Conference on Municipal Sludge Management and Disposal, August 18-20, 1975, Anaheim, California, p 23-25. 4 tab.

Problems associated with the design of small municipal waste water treatment plants are discussed, with a specific example being described. The example involves the design of a 6 million gallon/day activated sludge treatment plant which subsequently failed to meet state and Federal requirements despite original projections for future capacity needs and legislative changes. Problems encountered with the plant included: no replication of sludge handling equipment, inadequate storage and sludge thickening, makeshift sludge transfer, questionable sludge filter capacity, the use of an activated sludge system for solids storage, and various difficulties associated with a heat treatment unit. Conflicting requirements between the city's ability to comply in terms of financial resources and state and Federal demands for upgrading are discussed.

*Treatment facilities, *Waste water treatment, *Municipal wastes, *Sludge treatment, *Institutional constraints, Economics, Design criteria, Activated sludge, Waste treatment, Cities, Legislation

B037

TUNNELLING MACHINE USED FOR DRAIN TUNNEL FOR ROUNDHILL SEWAGE TREATMENT WORKS BREAKS RECORD,

Water Services, Vol. 80, No. 963, p 312, 316, May, 1976.

The construction of a 500-meter drain tunnel for a sewage treatment works is discussed, with particular emphasis on the tunnelling machine used which did the job in record time. The material being tunnelled consisted of Bunter pebble beds and Bunter sandstone. The tunnel shape chosen was one with a straight base and an arched roof. The machine chosen to drive the tunnel was an Atlas Copco Mini Full Facer which has also proven itself in such materials as dolomitic limestone, abrasive limestone, and metamorphus limestone. Up to 35.5 meters of tunnelling was accomplished in one day (20 digging hours) with the machine as compared to the previous record of 22 meters. The initial entry of the machine was aided by the construction of concrete walls at the starting end in order that the gripper pads would have solid material to push against. The machine is designed to work in a depth of 1 foot of water.

*Tunnel construction, *Tunnel design, *Tunneling machines, *Tunneling, *Drainage systems, Sewage treatment, Treatment facilities, Equipment, Construction, Hydraulic structures, Drains

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B038

FUNCTIONAL DESIGN OF SANITARY SEWERS,

Yao, K. M.

University of Engineering and Technology,
Lahore, Pakistan,
Institute of Public Health Engineering
and Research.

Journal Water Pollution Control Federation, Vol. 48, No. 7, p 1772-1778, July, 1976. 5 fig, 5 ref.

Criteria for the design of sanitary sewers are reviewed. The functional design of sanitary sewers involves the consideration of three items: hydraulics, self-cleaning action, and biochemical reactions. In current practice, it is assumed that self-cleaning of sanitary sewers is obtained by maintaining a minimum velocity of flow regardless of sewer size. However, a more rational approach may be to use the critical shear stress as the basis for the design of self-cleaning sewers since the basic mechanism of self-cleaning action is the hydrodynamic shear exerted on the sewer boundary by the flowing waste water. The design requirements of the critical shear stress approach for self-cleaning action tend to follow a pattern similar to those for hydrogen sulfide control. In both cases, the required minimum velocity increases with sewer size. For sewers with a Manning's roughness coefficient of 0.013 or less, a design critical shear stress in the range of 0.03-0.04 lb/sq ft will probably keep self-cleaning sanitary sewer systems free of hydrogen sulfide problems. For sewers with a Manning's roughness coefficient of 0.015 or greater, a design critical shear stress of 0.04 lb/sq ft seems preferable to achieve the same effects. These conclusions are valid at least within the size range up to about 60 in.

*Sewers, *Design criteria, *Hydraulics, *Chemical reactions, *Self purification, Hydraulic structures, Sanitary engineering, Engineering structures, Conveyance structures, Roughness coefficient, Hydrogen sulfide

B039
DEFUSING THE SEWAGE STINKBOMB ON THE TYNE,

Surveyor Public Authority Technology, Vol. 147, No. 4365, p 14-15, February, 1976.
1 fig.

The Northumbrian Water Authority's Tyneside Sewerage Scheme is described. The aim of the scheme is to remove the sewage nuisance currently plaguing the Tyne by treating the sewage and then taking it out to sea. Total cost of the project is estimated at 65 million pounds, and project completion is scheduled for 1980. Once the main interceptor sewers are complete, efforts will begin to take pumped sewage from the low-lying areas between the interceptors and the river banks into the interceptor system. The foul sewer system has been designed for the year 2054; thus, everything is oversized for present flows. In the early stages of the scheme, some storm sewage will be accepted through a storm overflow system. The balance of the stormwater will go into the river. As the system reaches design capacity, it will revert gradually to two separate systems.

*Sewage treatment, *Sewers, *Sewerage, *Storm water, *Hydraulic structures, Construction, Pipelines, Rivers, Surface waters, Projects, Costs, Combined sewers

Tyne river, Great Britain

C001
BIOLOGICAL PURIFICATION OF WASTE WATERS,

Australian Patent 468,494. Issued January 15, 1976. Official Journal of Patents, Trade Marks and Designs, Vol. 45, No. 49, p 5442, January, 1976.

A patent has been granted for equipment to treat waste water using activated sludge. At least two clarifier tanks are in communication with an aeration tank by means of openings in a wall or partition. Provision is made for recycling sediment from the clarification tanks to the aeration tanks. Air lift type pumps discharge into the aeration tank from each of the clarifiers. These clarifiers are fed with a pulsating intermittent flow of air, which subsequently causes a pulsating recirculation of the settled sludge into the aerator.

*Waste water treatment, *Activated sludge, *Patents, *Aeration, Equipment, Sludge treatment, Biological treatment, Tanks

*Clarification

C002
WASTE WATER PURIFICATION,

Knopp, P. V., and Gitchel, W. B.

Canadian Patent 981,815. Issued January 13, 1976. Patent Office Record, Vol. 104, No. 2, p 93, January, 1976.

A patent has been issued for a process to treat sewage. A combination of activated sludge for nitrification with an adsorbent such as powdered activated carbon is employed. This is followed by a denitrification step in the presence of additional adsorbent under anaerobic conditions.

*Patents, *Sewage treatment, *Waste water treatment, *Nitrification, Aerobic treatment, Activated sludge, Activated carbon, Adsorption, Denitrification, Anaerobic conditions

C003
MOBILE SEWER CLEANING MACHINE,

Prange, C. J.

Canadian Patent 984,809. Issued March 2, 1976. Patent Office Record, Vol. 104, No. 9, p 55, March, 1976.

A patent has been granted for a new mobile sewer cleaning machine. The support vehicle has a rearwardly open hose reel compartment. A cleaning hose reel is mounted in the compartment and rotates about a horizontal axis. The reel is fashioned in a drum with a diameter of at least twice the size of its axial width. A hose guide roller is mounted on the support vehicle behind and below the reel compartment and is positioned between the sides of the drum. Thus, during the winding, the hose will coil along the entire width of the drum without additional guidance.

*Sewers, *Patent, *Cleaning, *Equipment

C004
METHOD FOR THE PRIMARY AND SECONDARY TREATMENT OF WASTEWATER IN A UNITARY APPARATUS,

Torpey, W. N., and Sullivan, R. A.

Autotrol Corporation,
Milwaukee, Wisconsin. (assignee)

United States Patent 3,932,273. Issued January 13, 1976. Official Gazette of the United States Patent Office, Vol. 942, No. 2, p 884, January, 1976. 1 fig.

A patent has been granted for a continuous method of waste water treatment. A treatment tank with a primary bay and at least one secondary bay is used. Each of the bays includes a lower settling zone below its biological treatment zone, where the pollutants are oxidized. Waste water flows are created such that portions of waste water flow through the biological treatment zones in parallel and that waste water from the treatment zones of both the primary and secondary bays flows through the settling zone of the secondary bay in a direction away from one end of the tank and countercurrent to the direction of the waste water flow through the upper biological treatment zone of the secondary bay. As the last step in the process, treated waste water is removed from the settling zone of the secondary bay.

*Patents, *Biological treatment, *Waste water treatment, *Oxidation, Sedimentation, Tanks

C005
PHOSPHORUS REMOVAL FROM WASTE WATER,

Bykowski, M. J.

Canadian Patent 983,632. Issued February 10, 1976. Patent Office Record, Vol. 104, No. 6, p 97, February, 1976.

A patent has been granted for a process to reduce the phosphorus content of waste water. Part of the separated solids are recycled through part of the primary treatment process in order to first contact the waste water with products of an aqueous reaction with elemental iron. The mixture is then treated under aerobic and anaerobic conditions and the suspended solids fraction which contains the major portion of the influent phosphorus in a solid stable form is concentrated. A relatively clear liquid fraction may thus be separated from the effluent.

*Chemical precipitation, *Iron, *Nutrient removal, *Phosphorus, *Patents, Waste water treatment, Aerobic conditions, Anaerobic treatment, Separation techniques

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C006
METHOD AND APPARATUS FOR CHEMICALLY PURIFYING SEWAGE,

Tofaute, K.

Canadian Patent 984,528. Issued February 24, 1976. Patent Office Record, Vol. 104, No. 8, p 95, February, 1976.

A chemical precipitation method for purifying sewage has been patented. This method is especially useful for the removal of phosphorus. The sewage to be treated and the precipitating agent are mixed in a zone located in the upper region of a basin. After complete mixing, the liquid is passed downward through a flocculation zone into a sedimentation zone. Water freed from the flocculant sludge is conveyed upward into a clear water zone, which is separated from the mixing and flocculation zones by a partition wall.

*Chemical precipitation, *Waste water treatment, *Sewage treatment, Mixing, Nutrient removal, Flocculation, Sedimentation

C007
WASTE WATER TREATMENT PLANT,

Adjouri, A., and Cyr, R.

Canadian Patent 984,526. Issued February 24, 1976. Patent Office Record, Vol. 104, No. 8, p 95, February, 1976.

A waste water treatment facility which uses the complete mix principle to produce biological sludge and clarified water has been patented. The plant consists of an aeration chamber, a settling chamber and a partition between the two chambers. The partition includes several panel units, each with a baffle, an opening for the transfer of mixed liquor from the aeration chamber to the settling chamber, and a pair of recirculation ducts, secured against their baffle to form a framework. These ducts may be actuated by a controlled air flow and are situated so as to minimize the difficulties in plant flow characteristics.

*Waste water treatment, *Biological treatment, *Treatment facilities, Sludge treatment, Aeration, Sedimentation, Equipment, Flow characteristics, Mixing

Complete mix principle

C008
WASTE TREATMENT PROCESS,

Jeris, J. S., Beer, C., and Mueller, J. A.

Canadian Patent 986,239. Issued March 23, 1976. Patent Office Record, Vol. 104, No. 12, p 87, March, 1976.

A patent has been issued for a waste water treatment process involving denitrification. A fluidized bed containing denitrifying biota is generated on a particulate carrier. A carbon source is then metered into the waste water. Excess bacterial growth is mechanically removed from the carrier at predetermined intervals.

*Waste water treatment, *Denitrification, *Patents, Carbon, Biological treatment, Bacteria

Fluidized beds

C009
WASTE-WATER PURIFICATION,

Australian Patent 467,690. Issued December 11, 1975. Official Journal of Patents, Trade Marks and Designs, Vol. 45, No. 46, p 5063, December, 1975.

A newly patented process for treating waste waters by simultaneously removing organic carbonaceous material and biologically oxidizing the reduced nitrogenous forms is described. This procedure is followed by reduction of the oxidized nitrogen to elemental nitrogen. An aqueous suspension of adsorbent is introduced to the effluent while a non-condensible oxygen-containing gas is added to a vessel containing waste water, developing an active biomass with a sludge age of at least three days. Aerobic conditions are maintained for a period to oxidize ammoniacal nitrogen to nitrate or nitrate nitrogen. The adsorbent is settled and separated and associated adsorbed organic material and biological solids are returned to the vessel. The liquid phase is then passed to an anaerobic zone where further adsorbent and a source of organic carbon are added, reducing the oxidized forms to elemental nitrogen. Finally, the mixture is passed to a quiescent zone where the adsorbent and associated organic material may be removed from the waste water.

*Patents, *Waste water treatment, *Biological treatment, *Organic compounds, Oxidation, Nitrogen removal, Anaerobic treatment, Aerobic treatment, Sludge treatment, Separation techniques, Ammonia

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C010
ACTIVATED SLUDGE PLANT,

Uden, R. H.

Canadian Patent 982,283. Issued January 20, 1976. Patent Office Record, Vol. 104, No. 3, p 95, January, 1976.

A patent has been issued for an activated sludge treatment facility which is adapted to handle sewage loading. Raw sewage influent passes through the activated sludge process and is discharged as purified water. The plant has been designed for aerobic decomposition of raw sewage. In series, the influent is treated in a digester tank, several aeration tanks, a settling tank, and a final aeration tank.

*Patents, *Activated sludge, *Treatment facilities, Sewage treatment, Waste water treatment, Aerobic digestion, Tanks, Equipment

C011
METHOD OF TREATMENT OF SLUDGES WITH SIZE-ADJUSTED CARBON,

Seki, T.

United States Patent 3,933,634. Issued January 20, 1976. Official Gazette of the United States Patent Office, Vol. 942, No. 3, p 1435, January, 1976. 1 fig.

A process has been patented to concentrate and separate solids from solid/liquid mixtures in the treatment of sewage sludge. Fine dust coal or lignite particles (2 to 10% by weight) are incorporated into the sludge. These particles have a size distribution corresponding to a size distribution curve, as illustrated. The sludge and fine dust coal or lignite particles are mixed under agitation. After five to twenty minutes, a coagulant is introduced into this mixture, comprising iron and aluminum salts in an amount of from 1/50 to 1/10 by weight of the carbon particles. The resultant mixture is allowed to stand for 20 minutes to 2 hours, thus separating into a supernatant liquor and a coal-containing concentrated sludge. The concentrated sludge is fed onto a continuously moving filter cloth so that it crosses at a predetermined angle. This forms a precoat layer of coarse particles of the fine dust coal or lignite and a layer of coagulates composed of finer particles of the coal or lignite and sludge solid on the filter cloth. Vacuum suction filtration is conducted from the back surface of the filter cloth, thus removing water from the layer.

*Solids removal, *Patents, *Separation techniques, *Waste water treatment, *Sludge treatment, Carbon, Sewage sludge, Filtration, Lignite, Coals

Size adjusted carbon

C012
PURIFICATION OF EFFLUENT,

Boulenger, P.

L'Air Liquide,
Paris, France. (assignee)

United States Patent 3,945,916. Issued March 23, 1976. Official Gazette of the United States Patent Office, Vol. 944, No. 4, p 1905, March, 1976. 1 fig.

An oxygenation process has been patented for the purification of a waste-containing liquid with an oxygen-enriched gas in contact with a biologically activated sludge. The raw waste-containing liquid and the activated sludge are introduced into an inlet zone, forming a waste/sludge mixture. This mixture is fed upwardly through a preliminary oxygenation zone and then downwardly through a descending passageway. As the mixture is passed through the zone, oxygen-enriched gas is injected upwardly. Nondissolved gas is recovered at the top of the preliminary oxygenation zone. A predetermined portion of the recovered gas is discharged to the atmosphere and the remainder is recycled.

*Patents, *Waste water treatment, *Oxygen, *Aeration, *Activated sludge, Biological treatment, Recycling, Equipment

C013
AEROBIC SEWAGE TREATMENT SYSTEM,

Yost, K. J.

Canadian Patent 980,923. Issued December 30, 1975. Patent Office Record, Vol. 103, No. 52, p 93, December, 1975.

Liquid sewage from an individual residence is treated in a large, flat and shallow aerobic settlement tank by a patented method. This exposes a large surface area of the sewage per unit volume. Air is circulated over the surface in a spiral direction, thus effecting circulation or turbulence of the sewage within the tank and diffusion of air into the liquid. The liquid is then directed into an aerobic digestor and clarifier tank, which similarly circulates the treated liquid and diffuses the air in response to a spiral air flow created by a chimney draft. The second tank, therefore, is an annular clarifier chamber which receives the treated liquid before it is discharged. Discharged effluent is directed through a chlorinator and chlorine crystals are pushed downward into the path of the effluent by a combined weight and valve. This will stop the flow of treated liquid whenever additional chlorine crystals have not been added to the supply.

*Domestic wastes, *Patents, *Sewage treatment, *Aerobic digestion, *Sedimentation, Tanks, Equipment, Flow, Chlorine, Waste water treatment

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C014
UP-FLOW SEPARATOR,

Westfall, T. R.

Canadian Patent 982,492. Issued January 27, 1976. Patent Office Record, Vol. 104, No. 4, p 44, January, 1976.

Equipment and methodology for screening and concentrating waste water overflow from combined sewer systems have been patented. Such equipment includes a separator employing a substantially cylindrical rotating screen. Influent is piped upwardly into the system and deflected out toward the inner surface of the screen, thus achieving the desired flow rate and flow pattern of the influent onto the screen. Flow rate is controlled with several substantially discrete inclined streams. The screen is rotated at the correct speed to achieve the desired centrifugal force. A description of the handling of the influent, effluent, concentrate, and backsplash is provided, and the manner in which the influent is screened to achieve a fluid concentrate pumpable to other treatment equipment for ultimate disposal is also detailed.

*Patents, *Sewer systems, *Combined sewers, *Waste water treatment, *Separation techniques, Screens, Flow rates, Cleaning, Waste disposal

Up-flow separators

C015
PROCESS FOR TREATING SEWAGE SLUDGE AND FERTILIZER PRODUCTS THEREOF,

O'Donnell, J. M.

Orgonics, Incorporated,
Slatersville, Rhode Island. (assignee)

United States Patent 3,942,970. Issued March 9, 1976. Official Gazette of the United States Patent Office, Vol. 944, No. 2, p 809, March, 1976. 1 fig.

Sludge filter cake may be treated with a newly patented process. The sludge filter cake is reduced to a particle size of about 1/8th inch or less and the moisture content of the reduced sludge is decreased to between 30 and 50%, providing a partially dried sludge. In a reactor, an acid is added to the partially dried sludge, giving a pH of between 3 and 5. An alkaline N-methylol-urea aqueous prepolymer solution is prepared by the reaction of from about 1.1 to about 2.0 moles of urea per mole of formaldehyde. The prepolymer solution is immediately reacted with the partially dried sludge in a second section of the reactor, while continuously moving the sludge from the inlet to the outlet of the reactor at a temperature of from 30 to 80 C and a pH of 3 to 5. The sludge particles in the first and second sections of the reactor are vigorously mixed for a sufficient time to complete the reaction and conversion of the prepolymer. The reaction product is dried at a temperature of less than 95 C to a moisture content of about 3 to 10%, thus producing a granular, high-nitrogen, odorless fertilizer product.

*Sludge treatment, *Dewatering, *Patents, *Waste water treatment, Sewage sludge, Fertilizer, Filtration, Odor

Sludge filter cake

C016
APPARATUS FOR TREATMENT OF WATER, PARTICULARLY WASTE WATER,

Bosshard, E. J.

Canadian Patent 982,780. Issued February 3, 1976. Patent Office Record, Vol. 104, No. 5, p 7, February, 1976.

An invention for treating microorganism-containing waste water is described. The liquid is forced to circulate in a closed loop, flowing at least twice past one radiation source. Sufficient gamma radiation to destroy at least some of the microorganisms is employed.

*Waste water treatment, *Microorganisms, *Irradiation, *Gamma rays, Liquids, Disinfection

C017

METHOD AND APPARATUS FOR TREATING SEWAGE,

Huisman, P. H.

Gypsum Industries, Limited,
Transvaal, South Africa. (assignee)

United States Patent 3,939,067. Issued February 17, 1976. Official Gazette of the United States Patent Office, Vol. 943, No. 3, p 1343, February, 1976. 1 fig.

A new activated sludge sewage treatment method has been patented. Sewage within a chamber is given a spiral motion about the chamber center. The motion causes liquid-borne sludge in the chamber to flow from the chamber into and along a canal around the chamber. At least part of the liquid-borne sludge returns under the influence of gravity directly from the canal back into the chamber. An underflow weir permits sludge in the canal to flow directly from the canal into the chamber and a deflecting wall in the canal cooperates with the underflow weir.

*Patents, *Activated sludge, *Sewage treatment, *Waste water treatment, Weirs, Equipment

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C018

PROCESS FOR DEWATERING A PROTEINACEOUS, AQUEOUS SLUDGE AND FOR REMOVING AND RECOVERING PRECIPITATING AGENTS FROM A PRECIPITATE CONTAINING PROTEINACEOUS SUBSTANCES,

Nettli, P.

A/S Apothekernes Laboratorium for Specialpraeparater,
Oslo, Norway. (assignee)

United States Patent 3,936,375. Issued February 3, 1976. Official Gazette of the United States Patent Office, Vol. 943, No. 1, p 336, February, 1976. 1 ref.

A process to coagulate and agglomerate a proteinaceous aqueous sludge which has been previously precipitated has been patented. The sludge is separated from water contained within it and the precipitating agent is recovered. Sludge is mixed with calcium chloride. The pH is adjusted to a value in the range of 6.5 to 9.5 by adding a base selected from the group consisting of alkali metal hydroxides and alkaline earth metal hydroxides. The mixture is heated to a temperature between 60 and 120 C, thus coagulating and agglomerating the sludge. An aqueous phase containing the precipitating agent and a coagulated protein phase are thus formed. The aqueous phase containing the precipitating agent may then be separated from the coagulated protein phase.

*Waste water treatment, *Patents, *Chemical precipitation, *Sludge, Proteins, Dewatering, Recycling, Coagulation, Separation techniques

C019
FLUIDIZED FURNACE CONSTRUCTION FOR BURNING PARTLY DEHYDRATED SLUDGE,

Albrecht, E.

Rheinstrahl Aktiengesellschaft,
Essen, Germany. (assignee)

United States Patent 3,939,782. Issued February 24, 1976. Official Gazette of the United States Patent Office, Vol. 943, No. 4, p 1631, February, 1976. 1 fig.

A new configuration for a fluidized bed furnace to incinerate partially dehydrated sludge has been patented. The furnace housing has a bottom which forms a fluidized bed support, side walls which define a combustion chamber above the fluidized bed, an inlet for sludge through one side wall, and a discharge for the sludge on the opposite side wall. The housing bottom consists of numerous step portions arranged at distinct elevations in descending order from the inlet to the discharge. Means are also provided for directing air upwardly through the step portions to maintain the vertical operation of the bed and to support combustion in the combustion chamber.

*Waste water treatment, *Sludge treatment, *Sludge disposal, *Incineration, *Patents, Design, Equipment, Ultimate disposal

Fluidized bed furnace

C020
DOUBLE FUNNEL WITH BAFFLE CASCADE AERATION UNIT,

Murphy, D. S.

United States Patent 3,931,370. Issued January 6, 1976. Official Gazette of the United States Patent Office, Vol. 942, No. 1, p 525, January, 1976. 1 fig.

The design for an aerator for sewage has been patented. The apparatus is a double funnel with a baffled cascade aeration unit. It consists of an oxygen containing gas supply, two pairs of funnels, and baffle means. The oxygen containing gas supply means has two delivery orifices which cause the formation of two gas streams. The first two funnels converge downstream from the orifices so that the oxygen containing gas issuing from the orifice entrains liquids. The baffle means are located in the flow path between the exit from the first funnels and the entry to the second pair of funnels. The two pairs of funnels and the baffle means are secured together so that the mixture of oxygen containing gas and sewage leaving the first funnels impinges on the baffle.

*Waste water treatment, *Patents, *Aeration, *Equipment, Sewage treatment, Aerobic conditions

C021

CENTRIFUGE PREVENTING AIR ADMISSION DURING SLUDGE DISCHARGE,

Nelson, K.

The De Laval Separator Company,
Poughkeepsie, New York. (assignee)

United States Patent 3,390,609. Issued January 6, 1976. Official Gazette of the United States Patent Office, Vol. 942, No. 1, p 305, January, 1976. 1 fig.

A centrifuge design for sludge treatment has been patented. The special feature of this equipment is that air admission during sludge discharge is prevented. The sludge centrifuge comprises a centrifugal bowl rotating about an axis which forms a separating chamber with an inlet for a mixture of liquid and solids. The bowl also forms a paring chamber, connected to the separating chamber, where the liquid separated as a relatively light component from the liquid/solids mixture is collected. The separating chamber has an outer sludge space for receiving solids separated from the mixture as a relatively heavy sludge component. Means are provided to alternately open and close the outer edges of the bowl to discharge sludge intermittently from the sludge space. A stationary paring disk in the paring chamber discharges separated liquid from the bowl while its outer periphery is closed to maintain a normal liquid level in the bowl. This liquid level moves radially outward from the bowl axis in response to opening of the bowl's outer periphery. An air passage at the radially inner portion of the paring chamber provides a means for discharging air from the bowl to the atmosphere while the liquid is at the normal level. A dam rotating with the bowl limits the outward movement of the liquid level in the paring chamber, thus maintaining a minimum liquid level in the paring chamber during sludge discharge. Means in the paring chamber which are operable at the minimum liquid level prevent air from being pulled into the bowl through the air passage during sludge discharge.

*Waste water treatment, *Sludge treatment, *Centrifugation, Equipment, Patents, Separation techniques

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C022

EVAPORATOR-CONDENSER UNIT FOR PRODUCING POTABLE WATER FROM SEWAGE,

Taylor, F. W.

United States Patent 3,930,960. Issued January 6, 1976. Official Gazette of the United States Patent Office, Vol. 942, No. 1, p 415, January, 1976. 1 fig.

The design for an evaporator-condenser unit to produce potable water from sewage has been patented. The unit consists of an elongated enclosed housing defining a chamber. Means are provided for forcing hot combustion gases in a cyclonic pattern downwardly about the inside walls of the chamber. The hot gases impinge upon and pass about an array of tubes adjacent to the inside walls. Means for periodically cleaning particulate matter from the tubes include several injection nozzles, each positioned at the mouth of a corresponding tube. Relatively cool municipal waste water is pumped up through the tubes. The waste water cools the tubes, thus providing surfaces upon which the water vapor in the hot gases are condensed. The cyclonic wind action of the gases forces the condensation from the tubes downwardly in the chamber. The condensation is collected close to the bottom of the chamber while the gases are conducted away from the chamber after passing through the array of tubes.

*Waste water treatment, *Sewage, *Potable water, *Water reuse, *Patents, Equipment, Evaporation, Condensation

C023
SEWAGE TREATMENT SYSTEM,

Wilson, G. E.

Canadian Patent 980,924. Issued December 30, 1975. Patent Office Record, Vol. 103, No. 52, p 93, December, 1975.

A sewage treatment process using a high polymer ratio flocculation agent, biologically produced on site to flocculate the colloidal suspended solids upstream of the primary clarifier, has been patented. The flocculation agent is produced by subjecting microorganisms which are capable of generating polymeric material to a high food content in an aeration tank. Supernatant from the primary clarifier is passed into this tank. The microorganisms are then subjected to a low food content environment, thus generating polymeric material through the extracellular activity of the microorganisms.

*Patents, *Sewage treatment, *Flocculation, *Polymers, Waste water treatment, Aeration, Microorganisms

C024
METHOD AND APPARATUS FOR TREATING A CONTINUOUS FLOW OF FLUID WASTE PRODUCTS AND OTHER MATERIALS,

Varani, F. T.

Adrian Construction Company,
Dayton, Ohio. (assignee)

United States Patent 3,946,679. Issued March 30, 1976. Official Gazette of the United States Patent Office, Vol. 944, No. 5, p 2233, March, 1976.

A patent has been granted for a method to dry or burn a continuous flow of organic waste material. The material is pumped through an elongated rigid porous tube, forcing a gas radially inward through the pores of the tube, and into the material flowing through the tube. This creates a turbulence which disintegrates the material into fine particles and accelerates the flow of particles within the tube. The accelerated particles are then discharged from the tube and into a heating chamber where they expand. A flame is directed into the material, with air introduced into the disintegrated material after it is discharged, before being contacted with the flame.

*Patents, *Waste treatment, *Organic compounds, *Waste disposal, Burning, Equipment

C025
PHOSPHORUS REMOVAL FROM WASTEWATER,

Shell, G. L., and Burns, D. E.

Canadian Patent 985,805. Issued March 16, 1975. Patent Office Record, Vol. 104, No. 11, p 78, March, 1976.

A patent has been issued for a method to reduce the soluble phosphorus content of a phosphorus-containing liquid waste. A multi-zoned countercurrent reaction system is employed, including a final reaction zone and at least one preceding reaction zone. A metallic cation is added to the liquid waste as it enters the final reaction zone. An adsorptive sludge and an effluent containing a low residual phosphorus content are thereby produced. Effluent is discharged for further treatment or use and the sludge is removed from the final reaction zone and introduced into the preceding reaction zone containing the phosphorus-bearing liquid. Effluent from this zone is combined with a chemical and continuously fed into the final reaction zone. Thus, a chemical equilibrium may be maintained between the phosphorus present in the solid phase of adsorptive sludge and the residual soluble phosphorus present in the liquid phase of the effluent.

*Patents, *Phosphorus, *Nutrient removal, *Waste water treatment, Liquid wastes, Cations, Sludge treatment, Effluents

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C026
BIOLOGICAL TREATMENT OF STERILISED AQUEOUS WASTE,

Australian Patent 469,399. Issued February 12, 1976. Official Journal of Patents, Trade Marks, and Designs, Vol. 46, No. 4, p 369, February, 1976.

A method has been patented for treating water with organic contaminants. The sterile liquid produced by an initial sterilization step is mixed with sludge activated by a selected microorganism. Between one and 50% of the mixture's weight is sludge. This mixture is then contacted with an oxygen containing gas. The sludge and the liquor are separated; at least a portion of the sludge is recycled.

*Patents, *Waste water treatment, *Separation techniques, Microorganisms, Oxygen, Sludge treatment, Recycling

C027
SEWAGE PIPE FITTING,

Tetreault, A.

Canadian Patent 985,331. Issued March 9, 1976. Patent Office Record, Vol. 104, No. 10, p 10-72, March, 1976.

A sewage pipe fitting was patented consisting of a main body with a stack inlet at its top and a stack outlet at its bottom and one or more lateral stack inlets, preferably located between ventilating means. A first and a second arm are included in the ventilating means. Both are attached to and communicate with a main branch vent pipe. The ventilating means are provided so that a vent pipe independent of a sewage down pipe is unnecessary.

*Sewage treatment, *Patents, *Pipes, *Pipelines, Equipment, Waste treatment

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C028
METHOD FOR BIOLOGICALLY TREATING SEWAGE AND AN INSTALLATION FOR CARRYING OUT THE METHOD,

Schreiber, A., and Schreiber, B.

August Schreiber,
Hannover-Vinnhorst, Germany. (assignee)

United States Patent 3,947,358. Issued March 30, 1976. Official Gazette of the United States Patent Office, Vol. 944, No. 5, p 2453-2454, March, 1976. 1 fig.

An apparatus has been patented for biological treatment of sewage. It includes a circulation tank, which is elongated, and a longitudinal central partition extending upward from the bottom of the tank. The partition, which terminates adjacent to and at a distance from opposite end walls of the tank, defines parallel flow channels which are connected at opposite ends. The profile of the tank's end walls is outwardly curved and approximately semicircular. An aerator, which is mounted on a support, rotates about an axis perpendicular to the bottom wall, on the tank's longitudinal axis. Aeration of sewage is achieved as the aerator rotates; this equipment is located near its base. Sewage outlets and inlets on the tank open in the direction of flow within the tank. A partition extends toward the perpendicular axis, to decelerate the sewage circulating around the aerator. This partition has openings to allow the passage of the aerators and their air supply conduits. Baffles are mounted on the bearing support for rotating about the perpendicular axis. The partition openings also permit the passage of these baffles.

*Patents, *Biological treatment, *Sewage treatment, *Aeration, Equipment

C029
SLUDGE DEWATERING,

Cox, C. H.

United States Patent 3,938,434. Issued February 17, 1976. Official Gazette of the United States Patent Office, Vol. 943, No. 3, p 1137-1138, February, 1976. 1 fig.

A device was patented for dewatering sludge. The initial portion, succeeding portion, and terminal portion of its filter-dewatering shell each comprise means for fluid exit and solid particle retention. Filtrate collection means are located outside the shell. Central shaft means are located along the shell axis. The distance between the shaft means and the shell is a constant maximum in the initial portion; it decreases in the succeeding portion, reaching a minimum in the terminal portion. Means for cleaning the shell's inner surfaces and compressing and discharging filter cake are secured to the shaft. Power is provided for rotating the shaft means. The means for wiping and compressing and discharging filter cake have nozzles on their outer edge facing the shell. Fluid is supplied to clean out the exit to the nozzles

*Patents, *Sludge treatment, *Dewatering, Equipment, Filtration

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C030
METHODS AND APPARATUS FOR TREATING WASTEWATER,

Kirk, B. S., and Chappel, R. M.

Airco, Indorporated,
Montvale, New Jersey. (assignee)

United States Patent 3,933,640. Issued January 20, 1976. Official Gazette of the United States Patent Office, Vol. 942, No. 3, p 1347-1348, January, 1976. 1 fig.

Equipment was patented for oxygenating waste water which contains organic solids. It comprises an oxygenating chamber having sidewalls, top, and bottom in a body of waste water. It has an aperture in its bottom wall, means to pump waste water being treated through an inlet into the chamber, and means for creating turbulence in this waste water in a mixing zone in the chamber and for contacting the turbulent waste water with the oxygenating gas to dissolve oxygen and entrain oxygenating gas in the turbulent waste water. Liquid accumulation means are disposed within the chamber to receive oxygenated waste water from the mixing zone and to dissipate the turbulence. Nozzles are provided for discharging the oxygenated waste water into the waste water body at a velocity sufficient to maintain the organic solids suspended in the body of waste water. A plate member is supported and its rim portion is spaced away from the bottom wall at the aperture so that oxygenated waste water is discharged from the chamber in a predetermined multidirectional pattern into the body of waste water. An alternate form of the nozzle is described which includes an aperture in the lower part of one or more sidewalls, plate members above and below the aperture extending from the sidewall into the waste water body, and an adjustable cover.

*Patents, *Waste water treatment, *Dissolved oxygen, Oxygenation, Equipment, Mixing

C031
WASTEWATER TREATMENT,

Knopp, P. V., and Gitchel, W. B.

Sterling Drug Incorporated,
New York, New York. (assignee)

United States Patent 3,930,998. Issued January 6, 1976. Official Gazette of the United States Patent Office, Vol. 942, No. 1, p 427, January, 1976. 1 fig.

A process for removing nitrogen from waste water has been patented. Waste water which contains reduced nitrogenous compounds is mixed with nitrifying organisms and a gas containing oxygen for a length of time sufficient to convert practically all the nitrogenous material into a nitrate form. A nitrified waste water stream and accumulated biomass are produced. The accumulated biomass and nitrifying organisms are separated from the nitrified waste water stream and recycled to the nitrification contacting step. A portion of the accumulated biomass is periodically or continuously removed. The nitrified waste water stream is contacted with heterotrophic denitrifying organisms and an organic carbon source for a sufficient length of time to reduce the nitrate nitrogen to elemental nitrogen. The denitrifying organisms and accumulated biomass are separated from the denitrified waste water stream and recycled to the denitrification step, and a portion of the accumulated biomass periodically or continuously removed from the denitrification step. The biomass removed from the nitrification and denitrification steps is heated in the presence of an oxygen-containing gas at 175 C to 315 C at an oxygen partial pressure of 5 to 250 psi to partially oxidize the biomass and convert substantially all of the organic nitrogen to ammonia nitrogen. The resulting mixture is separated into solid and liquid phases. Ammonia is removed from the liquid phase, which is directed to the denitrifying contact step to provide a source of organic carbon for the denitrifying system.

*Patents, *Nitrification, *Denitrification, Waste water treatment, Ammonia, Nitrogen, Nitrates

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C032
SEWAGE TREATMENT APPARATUS,

Pacaud, J.

United States Patent 3,936,381. Issued February 3, 1976. Official Gazette of the United States Patent Office, Vol. 943, No. 1, p 338, February, 1976. 1 fig.

An apparatus for treating domestic sewage water was patented. It includes an outer tank with inlet and outlet means and an inner tank inside the outer tank. The bottom of the inner tank is vertically displaced from that of the outer tank. It has an aperture with means to prevent light particles from entering the outer tank. Means at the top of the inner tank create upwards suction to homogenize, aerate, and recirculate a bath and activated sludge in the inner tank. Floating means at the top of the inner tank protect against the turbulence which the aerating, homogenizing, and recirculating means create. Means at the top of the space between the inner tank and the outer tank trap light floating materials collected there and evacuate them from the top of the space.

*Patents, *Sewage treatment, *Equipment, *Tanks, Activated sludge, Flotation

C033
SEWAGE TREATMENT PROCESS,

Bauer, W. J.

United States Patent 3,939,066. Issued February 17, 1976. Official Gazette of the United States Patent Office, Vol. 943, No. 3, p 1342-1343, February, 1976. 1 fig.

A patent has been granted for a process to treat aqueous sewage which contains organic solids. The sewage is subjected to a positive pressure in a first zone; material is passed abruptly from this zone of positive pressure downward through a vertical conduit. This provides a reactor zone of near absolute zero pressure subadjacent to the receptacle and full conduit flow beneath the reactor zone. This also precludes the entry of air into the reactor zone. As the sewage is passed from the zone of positive pressure and through the reactor zone at a high velocity, the water vapor and gases are suddenly separated. This permits them to expand suddenly in the reactor zone, rupturing organic solids particles and disintegrating them into substantially smaller particles.

*Sewage treatment, *Patents, *Organic compounds, *Flow rates, Waste water treatment, Equipment

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C034
METHOD FOR TREATING SEWAGE WATER,

Fenn, R. W., and O'Leary, K. J.

Diamond Shamrock Corporation,
Cleveland, Ohio. (assignee)

United States Patent 3,943,044. Issued March 9, 1976. Official Gazette of the United States Patent Office, Vol. 944, No. 2, p 828-829, March, 1976. 1 fig.

A process has been patented for the treatment of sewage. In this electrolytic method, a sewage-containing alkali metal halide solution is provided to an upwardly tapered cell chamber which ends in a solids discharge outlet. Submerged dimensionally stable electrodes are located within the solution, and the solids are agitated and disintegrated. A direct electrolyzing current is passed between opposed dimensionally stable anodes and cathodes in the solution. The solution and solids are thereby disinfected and solids float to the top of the chamber. Solids and the entrained solution are removed through a solids discharge outlet.

*Patents, *Sewage treatment, *Electrolysis, Anodes, Cathodes, Solids removal, Disinfection, Waste water treatment

C035
SEWAGE TREATMENT AND RECYCLING SYSTEM,

Hadden, L. C., and Benjamin, C. T.

Environs Engineering Enterprises, Incorporated,
Honeybrook, Pennsylvania. (assignee)

United States Patent 3,933,641. Issued January 20, 1976. Official Gazette of the United States Patent Office, Vol. 942, No. 3, p 1348, January, 1976. 1 fig.

A sewage treatment system has been patented. Inlet means are located in the upper portion of the sidewall of a first container, where liquid is aerated. Outlet means are arranged opposite the inlet. The outlet is a conduit with a first open end located within the first container and a second open end located in the center of a second container. A trough is located beneath the second open conduit end to receive fluid. Its downwardly sloping sidewalls are peripherally arranged so that excess fluid flows over the surfaces of the sloping sidewalls, and is diverted by baffles into a filter system. The first filter means comprise a perforated support means. A second set of filters, comprising a mixture of sand, humus and alluvial deposits, is located beneath the first filter means. Filtered fluid is collected and removed.

*Patents, *Waste water treatment, *Sewage treatment, *Filtration, *Aeration, Biological treatment, Equipment

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C036
METHOD FOR ELIMINATING ORGANIC AND INORGANIC BOUND NITROGEN FROM DOMESTIC AND INDUSTRIAL WASTE WATER,

Dubach, M., and Scherler, A.

Canadian Patent 986,627. Issued March 30, 1976. Patent Office Record, Vol. 104, No. 13, p 83, March, 1976.

A method to eliminate organic and inorganic bound nitrogen from municipal and industrial waste water has been patented. A biological waste water treatment plant is utilized and consists of two stages connected in series. Each contains an aeration tank and a settling basin. Waste water entering the treatment plant will be aerated in the first stage aeration tank. It will subsequently be introduced into the settling basin where overflow is removed, free of oxygen. The mixture is then introduced into a second stage where it will again be aerated and subsequently introduced into a second stage settling basin. Favorable conditions for extensive nitrification of the ammonia are provided and a portion of the nitrified waste water is continuously recirculated from the settling basin of the second stage to the first stage. The recirculated portion of the waste water is denitrified in the settling basin of the first stage where ammonification of the organic bound nitrogen occurs as well as denitrification of the nitrate in the influent and the nitrate in the recirculated effluent.

*Patents, *Nitrogen, *Ammonia, *Waste water treatment, *Municipal wastes, Industrial wastes, Nitrification, Denitrification, Sedimentation, Treatment facilities

C037

SANITARY WASTE TREATMENT PLANT,

Eger, L. O., and Crosby, S. C.

Thetford Corporation,
Ann Arbor, Michigan. (assignee)

United States Patent 3,950,249. Issued April 13, 1976. Official Gazette of the United States Patent Office, Vol. 945, No. 2, p 824, April, 1976.

A plant for treating sanitary waste is patented. It comprises systems for delivery, biological treatment, and water recovery. The delivery system includes a flush-type toilet which has a demand actuator, a bowl for depositing sanitary waste, flush water supply means for transferring clear water from the water recovery system to the delivery system and for supplying the clear water as flush water under pressure to the bowl when the demand actuator is actuated, and delivery means to deliver the sanitary waste and flush water to the biological treatment system when the demand actuator is actuated. The biological treatment system biologically reduces the sanitary waste it receives and discharges an effluent to the water recovery system. The water recovery system includes ultrafiltration means to separate the effluent into an effluent concentrate and a water permeate. The ultrafiltration means has a tubular semipermeable membrane. Effluent is introduced into its one end axially under pressure and effluent concentrate discharged from the other. The ultrafiltration means also has a permeate collector tube surrounding the tubular membrane to collect, at a lower pressure, permeate passing through the membrane, and recirculation means which include a pump to return a portion of the effluent concentrate to the biological treatment system and for returning the remainder of the effluent concentrate at the first pressure to the ultrafiltration means to be further separated into water permeate and effluent concentrate, water storage means, and secondary filtration means to receive and polish the water permeate, in communication with the ultrafiltration means allowing the permeate to be discharged at the second pressure from the ultrafiltration means to the secondary filtration means for polishing and discharge as clear water to the water storage means. The water storage means communicates with the delivery system to transfer the clear water to it by flush water supply means.

*Patents, *Waste water treatment, *Biological treatment, Water reuse, Filtration

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C038

AERATED SEWERAGE DISPOSAL,

Smith, A. J.

United States Patent 3,951,804. Issued April 20, 1976. Official Gazette of the United States Patent Office, Vol. 945, No. 3, p 1347, April, 1976. 1 fig.

An aerated sewage disposal system has been patented. It comprises a septic tank, an enclosed compartment for aeration, and a rotary agitator. The septic tank has an inlet for sewage and an outlet for discharging liquids. The enclosed aeration compartment has an inlet to receive liquids directly from the discharge outlet of the septic tank and an outlet for aerated liquids. The compartment has side wall structure, a bottom wall, and rounded corners that extend between the side wall structure and the bottom wall. The rotary agitator is located in the enclosed aeration compartment to agitate liquids and cause them to flow downward in the compartment. A tubular shaft extends downward to approximately the agitator's level to carry and rotate the agitator and conduct air downward into the downward flowing agitated liquid. It has an air outlet in the compartment at approximately the agitator depth. A motor is connected to the upper end of the tubular shaft to rotate it. The rounded corners are located laterally and below the agitator sufficiently close to it to turn the flowing liquid, which contains air, upward along the side wall structure. The aeration compartment has vent means to allow air to pass between its interior and exterior. The volume of liquid and sewage in the tank, filled to its outlet level, exceeds the volume of liquid and sewage in the compartment when filled to the level of its outlet and more than 50% of the sewage solids are trapped in the tank. Control means connect with the motor, operating it intermittently, with substantially more time off than time on. There is a smaller additional tank with an inlet connected to the compartment outlet; an outlet connected to the leach line; and means, which include a pump, to return aerated liquids from the additional tank to the compartment.

*Waste water treatment, *Sewage treatment, *Sewage disposal, *Aeration, Patents, Equipment, Septic tanks

C039
SLUDGE REMOVAL SYSTEM,

Shaffer, R. L., and Mason, D. G.

Ecodyne Corporation,
Lincolnshire, Illinois. (assignee)

United States Patent 3,951,819. Issued April 20, 1976. Official Gazette of the United States Patent Office, Vol. 945, No. 3, p 1352, April, 1976. 1 fig.

An improved assembly for sludge removal in a circular clarifier tank having an inlet for receipt of liquid influent with entrained solids, an upper overflow outlet for removal of clarified liquid, and a bottom surface on which settled solids deposit is patented. The sludge removal assembly comprises a suction arm, sludge conduits, vertical riser tubes, a sightwell assembly, and valve assembly means for flow control. The suction arm has self-supporting sludge conduits of differing lengths which extend outward from and are mounted for rotation around an axis which is substantially vertical extending through the tank's center. The sludge conduits are secured to each other in a horizontal plane above the bottom surface of the tank. The sludge conduits have suction ports for inlet along their bottom surfaces adjacent to their outer ends to receive sludge from the bottom surface of the tank. The lower ends of many riser tubes which are substantially vertical are secured to the corresponding sludge conduits' inner ends. The sightwell assembly is positioned above the riser tubes' upper ends. Its lower portion is below the tank's static liquid level, and its upper portion is above the liquid level. Valve assembly means for flow control are associated with each riser tube's upper end for controlling the flow rates from the riser tubes into the sightwell assembly. These valve assembly means include adjustable orifice means whose lower portion is below the tank's static liquid level and whose upper portion is above this level.

*Waste water treatment, *Sludge treatment, *Sludge, Equipment, Patents

Sludge removal, Clarification

C040
SEWAGE TREATMENT TANK AND TUBE SETTLER,

Snyder, J. R.

Jet Aeration Company,
Cleveland, Ohio. (assignee)

United States Patent 3,951,817. Issued April 20, 1976. Official Gazette of the United States Patent Office, Vol. 945, No. 3, p 1351, April, 1976. 1 fig.

A tube settler has been patented which include numerous generally parallel spaced plates. Each plate has two faces, an opposed side, and end edge portions. Each plate also has numerous generally parallel spaced deflector members which extend outwardly from and are integrally connected to its first face and terminate adjacent to and spaced from an adjacent plate's second face. Each deflector member has wall means defining an elongated chamber with side walls tapering toward each other as they extend away from the plate to which they are connected. The elongated chamber also has opposed end walls. The deflector members extend outwardly generally perpendicular to the plates and in a direction at an acute angle to the side edge portions of the plates. The invention also includes means for holding the plates in their generally parallel spaced relationship.

*Waste water treatment, *Equipment, *Patents, *Settling basins, Sedimentation

Tube settlers

C041
SEWAGE DISPOSAL DEVICE,

Siegel, N. H.

United States Patent 3,951,803. Issued April 20, 1976. Official Gazette of the United States Patent Office, Vol. 945, No. 3, p 1346-1347, April, 1976. 1 fig.

A device for sewage disposal, adapted to receive discharge from a marine toilet, was patented. It incorporates means to kill coliform bacteria in the sewage. Storage tank means with an inlet to receive untreated sewage are included. Septum means within the tank means define an enclosure, vertically oriented. The septum means have lower and upper openings which communicate with the storage tank means' interior for recycling nonparticulated sewage. There are macerator means disposed in the vertically oriented enclosure with an impeller at its lower end. The enclosure has filtering screen means at its upper end, forming an outlet to pass particulated sewage impelled by the macerator. Pre-treatment storage means with an inlet bordering the screen which receives particulated sewage are also included. A compartment for sewage treatment is disposed beneath the pre-storage means. First valving means form an outlet at the pre-treatment storage means' lower end and an inlet to the sewage treatment compartment, allowing particulate sewage to pass by gravity from the pre-treatment storage means to the treatment compartment. Heating means are provided, including two electrodes disposed within the treatment compartment which operate automatically when sufficient particulate sewage is present, to form an ionizable fluid. Second valving means are disposed at the lowest part of the treatment compartment to form an outlet to drain it of treated waste. Thermostatic means are included for the treatment compartment, to determine completion of a treatment cycle and control operation of the valving means.

*Sewage disposal, *Sewage treatment, *Equipment, *Patents, Tanks, Filtration, Heat

Marine sewage disposal

C042
SLUDGE CONTROL AND DECANT SYSTEM,

Ward, T. D., and Ray, M. W.

Harsco Corporation,
Harrisburg, Pennsylvania. (assignee)

United States Patent 3,951,788. Issued April 20, 1976. Official Gazette of the United States Patent Office, Vol. 945, No. 3, p 1341-1342, April, 1976. 1 fig.

A system for sewage treatment is patented, comprising an aeration tank, a clarifier tank, a baffle between the aerator tank and the clarifier tank, a decant tank, gravity fluid flow communication means between the aeration tank and the decant tank, a pump and means connecting it for removing clarified liquid from the upper portion of the decant tank and to deliver the clarified liquid to the aeration tank, a sludge digester container, a sludge discharge line with a second pump, and first and second timer means. Means to aerate the waste water are included in the aeration tank. Liquid flows over the upper edge of the baffle from the aeration tank into the clarifier tank. The means for gravity flow communication have an intake at an elevation below that of the baffle's upper edge to prevent floating matter from entering the decant tank. The discharge line for sludge connects with the decant tank's lower portion and sludge digester container. The first timer means is connected to the first pump so that it will remove clarified liquid at selected intervals for selected time periods. The second timer means is connected to the second pump so that it will discharge sludge from the decant tank for selected time periods and at selected intervals to maintain the aeration tank's biological balance.

*Sewage treatment, *Patents, *Biological treatment, Aeration, Waste water treatment, Pumps

C043

APPARATUS FOR SEWAGE TREATMENT AND WASTEWATER RECLAMATION,

Shelef, G.

Hebrew University of Jerusalem,
Jerusalem, Israel,
Yissum Research Development Company. (assignee)

United States Patent 3,954,615. Issued May 4, 1976. Official Gazette of the United States Patent Office, Vol. 946, No. 1, p 246, May, 1976. 1 fig.

An improvement has been patented in a system to treat waste water using algae. The technology consists of a pond which contains means for channeling the waste water along an endless path and means to aerate and maintain the flow of waste water. According to the improvement, the pond is deeper beneath the aeration means than the path depth in the remaining parts of the pond. The greater depth provides a solubility gradient which increases the amount of oxygen than can be dissolved into the liquid by the aeration means.

*Waste water treatment, *Algae, *Lagoons, *Aeration, Biological treatment, Recycling, Oxygen, Ponds

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C044

SEPARATION OF SLUDGE,

Aldag, W.

United States Patent 3,953,328. Issued April 27, 1976. Official Gazette of the United States Patent Office, Vol. 945, No. 4, p 1847, April, 1976. 1 fig.

A method was patented for separating sludge and suspended material from the liquid being purified. Liquid flows into the clarification chamber by way of an aeration chamber. In the clarification chamber a rising liquid stream is established whose speed of flow decreases as this liquid rises. Suspended material in this rising stream is concentrated in an intermediate zone of the clarification chamber in which the tendency of the material to sink due to gravity is approximately equal to the tendency for it to be carried upward in the stream. The concentrated material is drawn off by suction means at the intermediate zone and at least partly fed back to the aeration chamber's upper zone. The suction means disposition is varied to the level of the intermediate concentration zone. The aeration chamber and the clarification chamber are in fluid communication to receive liquid in the rising stream from the former. The clarifying chamber is shaped to decrease the flow speed of the stream while the liquid rises. There are one or more pumps with an outlet in the aeration chamber and a suction pipe arranged with its inlet in the clarification chamber at an intermediate level between the outlet level and the fluid communication. The suction pipe inlet is at such a level that suspended material in the liquid stream, which concentrates at the intermediate zone, is drawn out of the clarification chamber with the pump to be at least partially returned to the aeration chamber at an upper level.

*Sludge treatment, *Patents, *Separation techniques, Suspended solids, Waste water treatment, Clarification, Aeration, Equipment

C045

SEWAGE TREATMENT PROCESS,

Parker, D. S.

Central Contra Costa Sanitary District,
Walnut Creek, California.

United States Patent 3,953,327. Issued April 27, 1976. Official Gazette of the United States Patent Office, Vol. 945, No. 4, p 1847, April, 1976. 1 fig.

A process has been patented for treating sewage which contains nitrogen compounds. First, nitrogen compounds are converted to the nitrate form by nitrification. The nitrified sewage is then subjected to substantially anoxic denitrification in the presence of methanol. The denitrified sewage is then stabilized by thoroughly aerating it under agitation conditions. The sewage is then flowed from the stabilization step and clarified, producing an effluent and sludge. The sludge is recycled directly to the denitrification step so that it will also be subjected to substantially anoxic denitrification. The purified effluent is withdrawn from the process.

*Waste water treatment, *Patents, *Sewage treatment, *Aerobic treatment, Nitrification, Denitrification

Anoxic conditions

C046

SEWAGE TREATMENT AERATION SYSTEMS,

Thayer, P. M.

Water Pollution Control Corporation,
Milwaukee, Wisconsin.

United States Patent 3,953,553. Issued April 27, 1976. Official Gazette of the United States Patent Office, Vol. 945, No. 4, p 1905-1906, April, 1976. 1 fig.

A prefabricated header-connector assembly adapted for inclusion in a sewage aeration tank by the attachment of a low pressure air supply and diffusers to several interconnected header-connector assemblies has been patented. It maintains the attached diffusers properly aligned in a common plane. It comprises a header and numerous connectors secured to it at different locations. The header is of weldable material with numerous nipples outwardly projecting from it at spaced locations. Each connector is oriented transversely to the header. The connectors have means for coupling with diffusers. Each connector has nipples drawn from it with their open ends welded to different header nipples.

*Patents, *Aeration, *Sewage treatment, Waste water treatment, Equipment

C047

METHOD AND APPARATUS FOR REJUVENATING A BED OF GRANULAR FILTER MEDIUM,

Hirs, G.

Hydromation Filter Company,
Livonia, Michigan.

United States Patent 3,953,333. Issued April 27, 1976. Official Gazette of the United States Patent Office, Vol. 945, No. 4, p 1849, April, 1976. 1 fig.

An improvement has been patented for a method of filtering lint-like and particulate contaminants from a contaminated liquid by passing it through granular filter medium in a bed contained in a housing where the contaminants accumulate and at least some particulate contaminants and the filter granules agglomerate. The improvement consists of renewing the filter medium bed after an appreciable quantity of contaminants accumulate. This is done by expanding the filter bed and violently agitating it to break the agglomeration into particulate contaminants and filter granules. The filter bed is reformed with the lint-like material predominantly in its upper portion, the larger broken-up particulates in the lowest portion, and the other particulates interspersed through the bed. Diluting liquid is introduced into the bed between its lower and upper surfaces. Simultaneously a portion of this liquid flows upward fairly rapidly through only the part of the bed above the point where the liquid is introduced to expand and upwardly backwash interspersed lint-like contaminants and particulates. A slurry of interspersed particulates and granular filter material mixed with the rest of the dilution liquid is separately withdrawn below the point where liquid is introduced and flows in a continuous path including a cleaning element which removes at least part of the particulates from the mixture. The filter material is returned to the bed in the liquid flow. The liquid flow is terminated after sufficient cleaning of the filter bed. The bed is then reformed for further filtation of dirty liquid.

*Patents, *Filtration, *Suspended solids, Equipment, Recycling

Granular filters

C048

STABILIZATION OF WASTE MATERIAL,

Bradley, E. H.

General Signal Corporation,
Rochester, New York. (assignee)

United States Patent 3,953,331. Issued April 27, 1976. Official Gazette of the United States Patent Office, Vol. 945, No. 4, p 1848, April, 1976. 1 fig.

A system has been patented to purify wastes. It includes two reaction tanks, each internally unobstructed, and means to deliver waste material for purification to the first tank. The delivery means include a conduit and a pump means. Means are also provided to introduce an oxidizing agent in the conduit in front of the pump means. A mixture of chemical oxidizing agent and waste material is pumped into the first reaction tank. Discharge conduit means from the first tank are directly connected to the delivery means and to the second tank to recirculate a portion of the mixture through the first tank and to deliver the remainder of the mixture to the second tank. Pressure is maintained in the tanks so that fairly rapid chemical oxidation can take place during the mixture's entire circulation through the tanks. A rotatable impeller tends to oppose the fluid flow from the second tank while the first pump pumps the pressurized fluid to the first tank. A method for stabilizing waste material is also included. An oxidizing agent is mixed with waste material to be stabilized, and the mixture is rapidly circulated under pressure in the second zone where the oxidation process continues. The mixture from the second zone is directed into a conduit. Flow is permitted through the two zones. The conduit and the rotatable impeller simultaneously maintain pressure in these zones by engaging the rotatable impeller in the conduit so as to tend to oppose flowing of the mixture from the second zone to the conduit.

*Patents, *Waste treatment, *Oxidation, *Equipment, Tanks, Aeration

C049
SEPTIC TANK SYSTEM,

Wilkerson, A. L.

United States Patent 3,954,612. Issued May 4, 1976. Official Gazette of the United States Patent Office, Vol. 946, No. 1, p 245-246, May, 1976. 1 fig.

A septic tank system has been patented. The septic tank has an inlet for receiving sewage and, just below its top, an outlet for the liquid effluent, with a tributary connected to it for the effluent, allowing it to soak into the ground. The tributary comprises an elongated ditch filled with a substance such as gravel to about the outlet's top and means in the tributary to indicate above the ground surface the effluent level in the tributary. The indicator facilities include a vertical conduit that extends from above the ground surface to the lowest part of the ditch that forms the tributary. The conduit has openings with the associated screen whose mesh size is selected to allow liquid entry into the conduit but not entry of gravel from the ditch into the pipe, allowing flow of effluent from the tributary into the conduit until the effluent level in the tributary is reached. A float in the conduit floats in the effluent. Means attached to this float extend above the surface of the ground to indicate the level of effluent in the tributary. Excess effluent can be pumped directly from the tributary before causing sewage back-up to the septic tank. This includes a second conduit that extends from the ground surface through the gravel to about the tributary bottom. This conduit has perforations adjacent to its bottom with the associated screen whose mesh size is selected to allow liquid effluent but not gravel from the ditch to enter the conduit. In this way, the effluent can be pumped from the tributary to substantially remove all the liquid effluent in the ditch.

*Septic tanks, *Patents, *Sewerage, *Waste disposal, *Conduits, *Equipment, Effluents, Sewage treatment, *Domestic wastes

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C050
WASTE TREATMENT PLANTS,

Davies, R. J., and Blows, D. G.

Foster Wheeler John Brown Boilers Limited,
London, England. (assignee)

United States Patent 3,954,605. Issued May 4, 1976. Official Gazette of the United States Patent Office, Vol. 946, No. 1, p 243, May, 1976. 1 fig.

A method was patented for disposing of sewage wastes and domestic solid materials on a ship or in a remote land site using a fluidized bed incinerator. The solid material may be combustible, noncombustible, or a mixture. The sewage wastes first enter a reception zone. After collection in the reception zone, the wastes are passed to a macerator. Flocculation aids are introduced to the sewage wastes after maceration. The sewage wastes are passed to a zone for pressure aeration where air is dissolved into them under pressure. The sewage wastes are then passed to another zone and fine air bubbles are liberated, transporting solid particles which have flocculated to the zone's surface and separating the sewage into a clarified liquor and a pulp, which can be fed to the fluidized bed incinerator. The clarified liquor is disinfected and then reused on the ship or in the remote land site or passed to the incinerator. Part of the pulp is returned to the pressure aeration zone. The pulp not returned is passed to a feeding zone of the incinerator. The solid materials are passed to a pulverization zone and converted to incineratable form which can be fed to the incinerator's fluidized bed region. Combustion conditions are provided in the fluidized bed incinerator. The solid materials are passed to the feeding zone. The pulp and the solid materials are mixed in the feeding zone of the incinerator. This mixture is fed directly to the incinerator's fluidized bed region. Any oil waste from the remote land site or ship is introduced into the fluidized bed incinerator.

*Patents, *Waste disposal, *Incineration, *Domestic wastes, *Sewage treatment, Flocculation

C051

PROCESS AND APPARATUS FOR THE INCINERATION OF AQUEOUS SEWAGE SLUDGE,

Loken, P. A.

Myrens Verksted A/S,
Oslo, Norway. (assignee)

United States Patent 3,954,069. Issued May 4, 1976. Official Gazette of the United States Patent Office, Vol. 946, No. 1, p 74-75, May, 1976. 1 fig.

A process and related equipment have been patented for incinerating aqueous sewage sludge, such as from community sewage treatment plants. The aqueous sewage sludge is mechanically dewatered to produce a wet sludge with high solids content. This wet sludge is indirectly heated and substantially dried in a heated drier, producing an exhaust gas containing water vapor and a dried sludge. The dried sludge is conducted to an incinerator for solid refuse. The exhaust gas is conducted through a condenser, condensing the water vapor and removing it, substantially drying the exhaust gas. This dry exhaust gas is conducted into the incinerator's combustion chamber. The exhaust gas is deodorized by heating with the aid of the hot combustion gases in the incinerator.

*Patents, *Incineration, *Sludge treatment, Sewage treatment, Solids removal, Dewatering, Odors

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C052

APPARATUS FOR TREATING INDUSTRIAL AND DOMESTIC WASTE WATERS,

Turner, A. B.

Degremont, S. A.,
Rueil-Malmaison, France.

United States Patent 3,956,128. Issued May 11, 1976. Official Gazette of the United States Patent Office, Vol. 946, No. 2, p 731-732, May, 1976. 1 fig.

A system to treat domestic and industrial wastes has been patented. It includes a tank, a filter in the tank, and an aerated packed column mounted above the filter in the tank. The column includes bacteria support media with approximately 50 sq ft/cu ft surface area. Screened sewage with suspended solids is introduced into the tank via an inlet and passed downward through the column and filter. Effluent outlet means are included at the lowest part of the tank to remove effluent. By-pass passage facilities which include a pump extend from the outlet to the lower portion of the tank for recirculating some of the effluent into the tank. Means are connected to the by-pass passage to aerate the recirculated effluent, to cause the air upon entering the tank to separate as small bubbles from the recirculated effluent, and to force these bubbles upward through the support media, providing oxygen for microorganisms growing on it that biologically remove the biochemical oxygen demand (BOD) loading in the sewage. Means positioned on the tank receive and burn floc rising to the tank's surface from the support media.

*Waste water treatment, *Patents, *Domestic wastes, *Industrial wastes, Equipment, Aeration, Biochemical oxygen demand

C053
SEWAGE SEPTIC SYSTEM FOR A PLURALITY OF DRAIN FIELDS,

Dempsey, J. G.

Langley Hill Quarry,
Woodside, California. (assignee)

United States Patent 3,956,137. Issued May 11, 1976. Official Gazette of the United States Patent Office, Vol. 946, No. 2, p 735-736, May, 1976. 1 fig.

A septic sewage system has been patented. It comprises a septic tank, numerous septic drain fields, and diversion means to direct the effluent to the drain field or fields selected. The septic tank supports a bacteriological action. It includes a sewage settlement compartment and an effluent compartment that communicates with the settlement compartment. An inlet pipe communicates with the settling compartment to deliver raw sewage. An outlet pipe communicates with the effluent compartment to discharge effluent. Each septic drain field has a pipeline to convey effluent. Diversion equipment is connected between the outlet pipe of the effluent compartment and the septic drain field pipelines. This includes an enclosure into whose interior the outlet pipe passes, having a lid to facilitate access to its interior, and a gate valve within the enclosure for each drainage field connecting the outlet pipe with its associated field's pipeline. Each gate valve has a housing connecting the outlet pipe with the pipe line. A gate within the housing can be moved between a position blocking flow between the outlet pipe and the associated drain field pipeline, and a retracted position that permits effluent flow from the outlet pipe through the pipe line.

*Patents, *Septic tanks, *Sewage treatment, *Drainage, Domestic wastes, Pipelines, Facilities, Waste disposal

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C054
WASTE PURIFICATION SYSTEM,

Hulls, J. R.

Bio-Kinetics Incorporated,
San Rafael, California. (assignee)

United States Patent 3,955,318. Issued May 11, 1976. Official Gazette of the United States Patent Office, Vol. 946, No. 2, p 464, May, 1976. 1 fig.

A continuous method to grow substantially unicellular algae, simultaneously purifying biodegradable wastes that contain aerobic bacteria, has been patented. Such a waste material would be sewage after comminuation and removal of most particulate matter, including nonbiodegradable matter, and after being largely freed from turbidity so that light can effectively penetrate it. An aqueous mixture of the algae and waste material is prepared. The waste material provides nitrogen and phosphorous for the algae and is mixed in an amount sufficient to support its growth. The mixture is aerated, agitated, and supplied with air and carbon dioxide in an amount balancing bacterial and algal growth. The agitated mixture is circulated in many cycles. It is then exposed in each cycle for approximately 0.5 sec to 2 sec to light to induce photosynthesis and then subjected to a dark period. Photosynthesis is effected without excessive oxidation of thylakoids, which are an inherent part of algae. The dark period is sufficient for regenerating the thylakoids. Algae are grown and substantially all of the waste material is consumed. An algae product and purified water effluent are separately recovered, recirculating some of the algae product.

*Algae, *Patents, *Sewage treatment, *Waste treatment, Nutrient removal, Aeration, Nitrogen, Phosphorus, Recycling

C055

WASTE TREATMENT APPARATUS,

Jeris, J. S., Beer, C., and Mueller, J. A.

Ecolotrol, Incorporated,
Bethpage, New York. (assignee)

United States Patent 3,956,129. Issued May 11, 1976. Official Gazette of the United States Patent Office, Vol. 946, No. 2, p 732, May, 1976. 1 fig.

Equipment has been patented to biologically denitrify water that contains oxidized nitrogen. It comprises a substantially vertically disposed elongated container, a manifold that is disposed toward the bottom of the container to control passage of water, an inlet to allow the container to receive water for processing, a fluidized bed of denitrifying microorganisms attached to a solid particulate carrier disposed in the container above the manifold, and means to add a carbon source to the fluidized bed. The fluidized bed is arranged to receive the water from the manifold and convert biologically substantially all the oxidized nitrogen being removed to water, nitrogen gas, and cellular material. The container has outlet means for receiving the processed water and at least some particulate carrier having excess cellular material. Means are provided for separating the processed water from the carrier. Processing means are connected to the separating means to receive the separated carrier, and for separating the excess cellular material and the particulate carrier.

*Biological treatment, *Patents, *Denitrification, Equipment, Waste treatment, Separation techniques
ationic acrylamide-styrene
Fluidized beds

C056

WASTEWATER TREATMENT SYSTEM WITH CONTROLLED MIXING,

Block, C. S., Chen, M. S., and Noichl, O. J.

Air Products and Chemicals, Incorporated,
Allentown, Pennsylvania. (assignee)

United States Patent 3,954,606. Issued May 4, 1976. Official Gazette of the United States Patent Office, Vol. 946, No. 1, p 243, May, 1976. 1 fig.

A method has been patented for oxygenating and reducing the biological oxygen demand of a mixed liquor. The mixed liquor flows through an aeration basin's elongated liquid zone. This zone is non-partitioned for 80% or more of the mixed liquor depth. Oxygen-rich aeration gas is introduced into the aeration basin. The mixed liquor is oxygenated with the aeration gas by rotating numerous surface aerators spaced along the length of the liquid zone. Surface baffles are provided between all or some of the surface aerators. The penetration depth of the surface baffles into the mixed liquor is maintained between 2 and 20% of the mixed liquor depth. The mixed liquor backflow ratio is controlled to produce effective liquid staging in the order of 30 to 80% or more by maintaining the aerator mixing factor between 10 and 550. The aerator mixing factor is revolutions per minute of the surface aerators multiplied by the ratio of the diameters to the linear velocity of the liquid through the liquid zone.

*Patents, *Biochemical oxygen demand, *Aeration, *Oxygenation, *Waste water treatment, Equipment, Mixing

C057

CATIONIC ACRYLAMIDE-STYRENE COPOLYMERS AND FLOCCULATION OF SEWAGE THEREWITH,

Coscia, A. T., Panzer, H. P., and Sedlak, J. A.

American Cyanamid Company,
Stamford, Connecticut. (assignee)

United States Patent 3,956,122. Issued May 11, 1976. Official Gazette of the United States Patent Office, Vol. 946, No. 2, p 730, May, 1976.

A process has been patented to flocculate solids suspended in an aqueous medium. An effective but small amount of an aqueous dispersion of a cationic vinyl polymer is uniformly added to the medium as flocculant for the solids. The polymer comprises 40 mol percent or more of N-[di(C1-3alkyl)aminomethyl]acrylamide hydrophilic cationic linkages, at least 5 mol percent of vinyl hydrophobic linkages, and up to 10 mol percent of acrylic acid hydrophilic anionic linkages. The number of hydrophobic linkages is large enough for the polymer to be insoluble in pure water and small enough for the polymer to be auto-dispersible in pure water. The polymer is distributed through the medium, flocculating a substantial portion of the solids. The flocculated solids and the medium are separated.

*Patents, *Waste water treatment, *Flocculation, *Polymers, *Separation techniques, Suspension, Suspended solids, Emulsions

Cationic arylamide-styrene

C058

REMOVAL OF PHOSPHATE FROM WASTE WATER,

Kleber, E. V., and Recht, H. L.

United States Patent 3,956,118. Issued May 11, 1976. Official Gazette of the United States Patent Office, Vol. 946, No. 2, p 728-729, May 11, 1976. 1 fig.

A patent for a chemical treatment process which removes phosphate-containing anions from waste water is presented. The process involves adding a trivalent rare earth cation in soluble form to the waste water to form an insoluble rare earth precipitate of the trivalent rare earth cation and the phosphate-containing anions in the waste water. This precipitate is then separated from the waste water.

*Waste water treatment, *Chemical precipitation, *Patents, *Phosphates, *Anions, Chemical wastes, Cations, Chemical reactions, Separation techniques, Treatment

Rare earth cations, Anion removal

C059

SEWER PEST CONTROL CHECK VALVE,

Diaz, B.

United States Patent 3,955,596. Issued May 11, 1976. Official Gazette of the United States Patent Office, Vol. 946, No. 2, p 560, May, 1976. 1 fig.

A valve section for sewer pipe was patented. It has a pipe portion having opposite circular ends to interconnect with adjoining pipe sections and a housing extending upward from the midportion of the pipe portion with an open top that has a removable cover. A lower end of the pipe portion has an interior shoulder. The valve support frame, which rests on this shoulder, can be removed vertically through the open top. A one-way flapper valve pivotally mounted on a horizontal axis in the frame connected from it into the pipe portion, swinging from a normal closed position that obstructs reverse sewage flow to a position responsive to flow of material towards a sewer outlet. A rod is upstanding from the frame. A screen upstream of the valve is mounted in the housing to move vertically from a normal raised inoperative position in the housing to the operative lowered position in the pipe portion. Disengageable linkage means act between the rod and screen to secure the screen in the raised position when the frame rests on the shoulder and are disengaged to release the screen for lowering to the operative position when the valve and frame are removed to clean the pipe.

*Patents, *Sewers, *Valves, *Pipes, *Flow control, Screens, Mechanical equipment, Outlets

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C060

APPARATUS AND METHOD FOR REMOVING POLLUTANTS FROM WASTEWATER,

Ramirez, E. R., and Johnson, D. L.

Swift and Company,
Chicago, Illinois. (assignee)

United States Patent 3,959,131. Issued May 25, 1976. Official Gazette of the United States Patent Office, Vol. 946, No. 4, p 1738, May, 1976. 1 fig.

A patent for a raw waste water treatment system is described. The system includes a tank into which the waste water is introduced and a bubble introduction means located below and in communication with the tank for supplying a dense zone of fine bubbles to the tank. The pollutants in the waste water combine with the bubbles to form aggregates which remain unseparated from the waste water flow. The aggregates and treated waste water flow are removed through a transfer conduit to a flotation basin for separation of the pollutants and bubbles from the clarified waste water.

*Patent, *Waste water treatment, *Treatment facilities, *Flotation, *Aggregates, Treatment, Equipment, Wastes, Separation techniques, Bubbles

C061

CONTINUOUS RESPIROMETER APPARATUS FOR MONITORING SEWAGE OXYGEN CONTENT,

Robertshaw Controls Company,
Richmond, Australia. (assignee)

Australian Patent 470,334. Issued March 11, 1976. Official Journal of Patents, Trade Marks and Designs, Vol. 46, No. 8, p 773, March, 1976.

A continuous respirometer apparatus to monitor the oxygen contained in sewage in a holding area was patented. It includes a continuous closed flow path formed on its upstream end with an inlet sensing area, and an outlet sensing area on its downstream end. A residence chamber is defined, having a known volume. A pre-aeration vessel is included with an outlet connected to the inlet in the closure area and an inlet for receiving the fluid. Means are included to introduce oxygen to the pre-aeration vessel to add oxygen to the fluid. Outlet and inlet probes sensing oxygen content are disposed in the outlet and inlet sensing areas to continuously sense the oxygen content of the sewage flowing through the outlet and inlet areas. The invention includes supply conduits that lead from the holding area to the pre-aeration vessel inlet to deliver sewage. Dump conduits lead from the outlet sensing area. Sewage delivery equipment continuously delivers sewage to the inlet sensing area. The sewage delivery rate is predetermined to maintain the volume filled and to provide a known residence time required for the sewage to flow between the inlet probe and outlet probe. The means for sewage delivery may be actuated for continuous delivery to the inlet sensing area, also causing flow of the sewage from the inlet probe to the outlet probe while isolated from ambient oxygen and causing the probes to indicate the oxygen content of the sewage at both the outlet and inlet sensing areas.

*Sewerage, *Analytical techniques, *Oxygen, *Monitoring, *Patents, Dissolved oxygen analyzers, Measurement, Aeration

*Respirometers

C062

WASTE WATER TREATMENT,

Westinghouse Electric Corporation,
Melbourne, Australia.

Australian Patent 470,038. Issued March 4, 1976. Official Journal of Patents, Trade Marks and Designs, Vol. 46, No. 7, p 663, March, 1976.

A waste water treatment system was patented. It includes an enclosure with an inlet adapted for receiving sewage influent for conditioning, separate liquid and solids outlets, and a liquid-solids separator in the enclosure receiving the influent to separate the solid and the liquid and to deliver the solids to the solids outlet. An incinerator which is associated with the outlet burns the solids delivered to it. A surge conditioning tank associated with the liquid outlet receives the liquid that has been separated. Chemical feed means connect with the tank to introduce chemical substances to condition the liquid. Filtration-absorption means connect with a tank outlet to remove colloidal material not removed by the separator. The filtration-absorption means include at least a stripper column with a mixture of various kinds of granules. One kind is chosen from materials having positive electrode potentials compared to hydrogen and another from materials having negative electrode potentials compared to hydrogen.

*Waste water treatment, *Sewage treatment, *Sewerage, *Treatment facilities, *Patents, Separation techniques, Incineration, Disposal, Solid wastes, Liquid wastes, Filtration, Absorption, Colloids, Granules

C063

PROCESS FOR DECONTAMINATING SEWAGE CONTAINING CYANIDE,

Kloster, H., Preusser, G., and Radusch, P.

Heinrich Koppers Gesellschaft mit beschrankter Haftung,
Essen, Germany. (assignee)

United States Patent 3,959,130. Issued May 25, 1976. Official Gazette of the United States Patent Office, Vol. 946, No. 4, p 1738, May, 1976.

A process for decontaminating sewage containing cyanide was patented. The cyanide is removed from sewage by maintaining the sewage in contact with a fly ash product produced during the gasification or combustion of coal dust, lignite, or coal at pH 7 or greater for 10 minutes or more. The fly ash product particles are smaller than approximately 25 microns. The sewage and the fly ash product are then separated.

*Waste water treatment, *Sewage treatment, *Sewerage, *Chemicals, *Fly ash, *Patents, Hydrogen ion concentration, Separation techniques, Particle size

*Cyanide

C064

TREATMENT AND DISPOSAL OF SEWAGE SLUDGE,

Teletzke, G. H.

Sterling Drug Incorporated,
New York, New York. (assignee)

United States Patent 3,959,125. Issued May 25, 1976. Official Gazette of the United States Patent Office, Vol. 946, No. 4, p 1737, May, 1976.

A process was patented to condition sewage sludge for land disposal. The sludge is rendered free of viable plant seeds and disease-producing microorganisms by heating it to between approximately 65 C and 150 C for between about 30 seconds and 60 minutes. The time and the temperature vary inversely. Without separating liquid and solid phases, the resulting fluid sterilized sewage sludge is biologically digested at a temperature between about 32 C and 60 C.

*Biological treatment, *Heat treatment, *Sludge treatment, *Patents, *Landfills, *Sewage sludge, Sludge disposal, Microorganisms, Seeds

C065
SEWAGE HANDLING AND DISPOSAL PROCESS FOR CHLORIDE (NACL) CONTAMINATED SLUDGES,

Millward, R. S.

Dorr-Oliver Incorporated,
Stamford, Connecticut. (assignee)

United States Patent 3,959,126. Issued May 25, 1976. Official Gazette of the United States Patent Office, Vol. 946, No. 4, p 1737, May, 1976.

A method was patented to treat sewage that contains sodium chloride from infiltration by salt water. It is suitable for sodium chloride concentrations that become corrosive at temperatures used to sterilize sludge. The sewage is treated to produce biologically treated sludge. This biologically treated sludge is centrifugally separated and concentrated in a nozzle type centrifuge. An underflow fraction with a controllable concentration and an overflow separated liquid fraction are delivered through the machine's nozzles. Wash water is fed into the separating chamber at a rate effectively blocking sodium chloride from discharging with the underflow fraction by displacing the sodium chloride by the wash water toward overflow, delivering underflow sludge substantially free of sodium chloride and an overflow that contains the displaced sodium chloride. This underflow sludge is heated by passing through heating apparatus which could otherwise be corroded by the sodium chloride at sterilizing temperatures.

*Patents, *Waste water treatment, *Sewage treatment, *Sewerage, *Treatment facilities, *Sewage sludge, Biological treatment, Sodium chloride, Centrifugation

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C066
TREATMENT OF WASTE WITH OXYGEN OR OZONE,

Australian Patent 470,115. Issued March 4, 1976. Official Journal of Patents, Trade Marks and Designs, Vol. 46, No. 7, p 683, March, 1976.

A process for treating liquid wastes with oxygen or ozone has been patented. Such wastes have an oxygen demand sufficient that when the liquor is contacted with a treatment gas having an oxygen content in the range 70 to 95% by volume, at least a part of the effluent gas produced is subjected to an enrichment step. This will restore its oxygen content to the treatment level. The oxygen is then recycled.

*Liquid wastes, *Waste treatment, *Patents, *Ozone, *Oxygen, Waste water treatment, Recycling, Chemical oxygen demand

C067
TRACTION-DRIVEN COMPOSITE SLUDGE RAKING MECHANISM FOR SEDIMENTATION TANKS,

Seifert, J. A., Hill, D. R., and Smith, M.

Dorr-Oliver, Incorporated,
Stamford, Connecticut. (assignee)

United States Patent 3,959,152. Issued May 25, 1976. Official Gazette of the United States Patent Office, Vol. 946, No. 4, p 1746, May, 1976. 1 fig.

A patent for a sludge raking mechanism for sedimentation tanks is described. A bladed rake arm extends from the lower end of a vertical cage structure surrounding a center pier near the discharge means of a settling tank and swings from a predetermined lowermost normal raking position to move the sludge toward the discharge means. The rake arm yields upwardly along the predetermined path when excessive sediment accumulation in the inner zone of the settling tank occurs. An outer complementary raking means functions to move light sedimentation sludge loads from an outer annular zone to the inner zone of sedimentation sludge accumulation.

*Patent, *Sludge treatment, *Sediment discharge, *Settling basins, *Sediment control, Waste treatment, Treatment facilities, Sedimentation, Treatment, Equipment, Sediments, Wastes

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C068
WASTE TREATMENT PROCESS,

White, H. R., and Doncer, A. J.

Alar Engineering Corporation,
Bedford Park,
Chicago, Illinois. (assignee)

United States Patent 3,959,129. Issued May 25, 1976. Official Gazette of the United States Patent Office, Vol. 946, No. 4, p 1737-1738, May, 1976. 1 fig, 1 tab.

A patent involving a process for treating waste waters derived from the clean-up of at least one water-based flexographic printing ink and from the clean-up of at least one starch based adhesive used in corrugated paper board manufacturing is described. The process involves the addition to the waste water of 500-5000 ppm of dissolved, water-soluble iron salt (selected from ferrous sulfate, ferric sulfate, or ferric chloride); agitation of the resulting mixture for a period of 20 min to 4 hr; mixing the agitated mixture with 500-5000 ppm of calcium hydroxide (composed of particles less than 250 micron); agitation of the resulting mixture for a period of 20 min to 4 hr; and the continuous passage of the resulting mixture over the surface of a rotating drum vacuum filter assembly which is coated with a layer of water-insoluble, inert particulate material having a particle size less than about 250 microns. The aqueous portion of the mixture is simultaneously withdrawn through the surface portion of the rotating drum, while the filter cake deposited on the outer surface portion of the drum is moved along a longitudinal path of the drum. The waste water treated should contain a 4000-60,000 ppm of suspended solids with an average diameter below about 200 millimicron and 1-6 weight % non-aqueous matter.

*Patent, *Waste water treatment, *Industrial wastes, *Chemical reactions, *Solubility, *Filtration, Treatment, Wastes, Adhesives

Printing wastes, Paper board wastes

C069

METHOD AND APPARATUS FOR THE ACTIVATED SLUDGE TREATMENT OF WASTEWATER,

Tchobanoglous, G.

SWECO, Incorporated,
Los Angeles, California. (assignee)

United States Patent 3,959,124. Issued May 25, 1976. Official Gazette of the United States Patent Office, Vol. 946, No. 4, p 1736-1737, May, 1976. 1 fig.

A patent for an activated sludge waste water treatment method and apparatus is described. The apparatus includes an aeration basin and a secondary clarifier along with a screening means arranged for receiving at least a portion of the flow from the aeration basin for solids removal. The screening means includes at least one screen and a distribution means for directing the flow with a substantial relative movement itself and the screen so that the screen is maintained unclogged. The screening means divides the flow into a screened effluent and a concentrate. The former is directed to the secondary clarifier and the latter to the aeration basin for control of the mean cell residence time in the aeration basin.

*Patent, *Waste water treatment, *Activated sludge, *Aeration, *Screens, Treatment facilities, Equipment, Wastes, Treatment

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C070

RECIRCULATING SEWERAGE SYSTEM,

Bogusz, F. J.

Koehler-Dayton, Incorporated,
New Britain, Connecticut. (assignee)

United States Patent 3,958,279. Issued May 25, 1976. Official Gazette of the United States Patent Office, Vol. 946, No. 4, p 1460, May, 1976. 1 fig.

A patent for a recirculating sewerage system is described. The sewage system consists of a toilet, a recirculating tank, a drain conduit which communicates with the bottom of the recirculating tank, a valve for controlling the gravitational flow of sewage from the recirculating tank through the drain conduit, and a means for directing the effluent from the toilet into the recirculating tank. When the system is operated in the flushing mode, a means for energizing a pump communicating with the recirculating tank is provided along with a means for recirculating the effluent discharged by the pump to the toilet for flushing purposes. Means are also provided for operating the system in a drain mode whenever the recirculating tank is to be drained.

*Sewage treatment, *Waste water treatment, *Sewerage, *Recycling, *Patent, *Treatment facilities, Equipment, Treatment, Sewage disposal, Waste disposal, Wastes, Sewage effluents

C071
ACID TREATED CATIONIC STARCH IN THE FLOCCULATION AND DEWATERING OF SLUDGE,

Hunt, W. G., Belz, R. J.

United States Patent 3,962,079. Issued June 8, 1976. Official Gazette of the United States Patent Office, Vol. 947, No. 2, p 754, June, 1976.

A patent for a process to flocculate and dewater municipal raw primary sludge is presented. The process involves adding between 0.007-0.200% (based in dry weight of the sludge) of an acid treated gelatinized cationic starch ether of amine butene halide to the sludge. The degree of amine butene halide substitution in the reagent is between 0.15 and 0.25, and the reagent fluidity ranges between 30-50 ml. The sludge is then dewatered to approximately below 70% moisture.

*Patents, *Sludge treatment, *Flocculation, *Dewatering, Municipal wastes, Cations

Starches

C072
PROCESS FOR THE PURIFICATION OF WASTE WATERS,

Pascarella, G., and Salvemini, F.

Tecneco S.p.A.
Fano (Pesaro), Italy. (assignee)

United States Patent 3,962,077. Issued June 8, 1976. Official Gazette of the United States Patent Office, Vol. 947, No. 2, p 753, June, 1976. 1 fig.

A patent for a process to treat wastes containing resins used for processing sugar juices is described. The process involves the following steps: feeding waste water from the regeneration of decoloring resins to a reverse osmosis section; feeding waste waters from the regeneration of anionic and cationic demineralizing resins to anodic and cathodic compartments, respectively, of electrolytic cells for electrolysis; mixing and neutralizing the treated cationic and anionic streams, subjecting the waters to a reverse osmosis treatment, and mixing them with treated solution from the first step; feeding the treated water from the last step to an evaporator for recovery of dry organic compounds; and feeding water from the regeneration of decalcifying resins to a precipitation section containing sodium hydroxide and carbon dioxide and subsequently neutralizing the water prior to a final reverse osmosis treatment. The waste water treated contains both inorganic and organic compounds which may or may not be ionizable.

*Waste water treatment, *Patents, *Industrial wastes, *Resins, Reverse osmosis, Electrolysis, Chemical precipitation, Neutralization, Evaporation, Organic compounds, Inorganic compounds, Recycling

C073

PROCESS FOR CONVERTING AQUEOUS SEWAGE TO POTABLE WATER,

Hess, H. V., Franz, W. F., and Cole, E. L.

Texaco, Incorporated,
New York, New York. (assignee)

United States Patent 3,962,076. Issued June 8, 1976. Official Gazette of the United States Patent Office, Vol. 947, No. 2, p 752-753, June, 1976. 1 fig.

A patent for a process to convert aqueous sewage containing dissolved brine-forming minerals and organic compounds to potable water and coke is described. The process involves the following steps: separating the sewage into a primary sludge and a relatively cool primary effluent containing the dissolved minerals; passing the effluent into direct counter-current contact with relatively hot hydrocarbon liquid under a pressure of 1000-3000 lbs/sq. in. and at a temperature of between 600 and 700 F, thereby forming a hydrocarbon minerals-free water solution, a cooled hydrocarbon, and a hot concentrated minerals-containing brine solution; separating the hydrocarbon from the water; flashing at least a part of the water; condensing the water for potable use; pressurizing the sludge to around 1000-3000 lbs/sq in.; and injecting the hot brine into the sludge in order to coke the sludge in the liquid phase and form a reject coker effluent, gases, and coke.

*Sewage treatment, *Water reuse, *Potable water, *Water purification, *Patents, Organic compounds, Mineral water, Brines, Sludge, Byproducts, Separation techniques

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C074

SYSTEM FOR TREATING SLUDGE,

Inoue, K., and Shimizu, A.

Inoue-Japan Research, Incorporated,
Yokohama, Japan. (assignee)

United States Patent 3,962,069. Issued June 8, 1976. Official Gazette of the United States Patent Office, Vol. 947, No. 2, p 750, June, 1976. 1 fig.

A patent for a device which treats sludge is described. The apparatus consists of the following components: a vessel for receiving a bath of the sludge, an electrically conductive member with a screen-like perforated surface that is continuously displaceable through and outside of the bath along a predetermined path to form a first electrode, a second electrode juxtaposed with the first electrode in the bath, a power supply for applying an electric potential across the two electrodes to electrochemically effect a flow of water from the sludge through the electrode perforations on which the sludge deposits, a means for removing the sludge deposits from the perforated surface, a means for detecting the water content of the sludge deposit, and a means for controlling the electrical potential of the apparatus so that a desired water content of the sludge deposit can be maintained.

*Patents, *Sludge treatment, *Electrochemistry, *Dewatering, Waste treatment, Equipment, Electrodes

C075
PROCESS FOR TREATING WASTE WATER,

Wyatt, K.

Air Products and Chemicals, Incorporated,
Allentown, Pennsylvania. (assignee)

United States Patent 3,960,717. Issued June 1, 1976. Official Gazette of the United States Patent Office, Vol. 947, No. 1, p 305, June, 1976. 1 fig.

A patent for an activated sludge process designed to treat waste water containing organic matter and dissolved nitrogen gas is described. The waste water is first pretreated in an enclosed zone by contact with an oxygen enriched stripping gas having an oxygen content in excess of that of air and a nitrogen partial pressure less than that of air. At least 25% (by weight) of the dissolved nitrogen gas is stripped from the waste water and vented from the pretreatment chamber. The pretreated waste water is then introduced along with recirculated activated sludge into an enclosed aeration zone where an oxygen enriched aeration gas is also introduced. Biological degradation of the organic matter in the waste water occurs in this enclosed mixed liquor aeration zone. The mixed liquor is then discharged from the aeration zone, with the activated sludge being separated from the liquor and recirculated back to the aeration zone. The oxygen enriched stripping gas used in the pretreatment stage consists of at least some oxygen enriched aeration gas withdrawn from the mixed liquor aeration zone of the apparatus.

*Patents, *Waste water treatment, *Activated sludge, *Aeration, *Organic compounds, *Nitrogen, Gases, Oxygen, Biological treatment, Separation techniques, Recycling

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C076
METHOD OF PROCESSING REFUSE AND/OR SLUDGE AND A PLANT FOR CARRYING OUT THE METHOD,

Kaelin, J. R.

United States Patent 3,960,537. Issued June 1, 1976. Official Gazette of the United States Patent Office, Vol. 947, No. 1, p 255-256, June, 1976. 1 fig.

A patent for a biological conversion process and apparatus designed to form compost from refuse or thickened sludge is described. The material to be treated is placed into the top of a continuous treatment chamber where it is permeated with a gas mixture delivered under elevated pressure by several gas distributor blades in the chamber. The distributor blades are rotated about an axis which is parallel to the direction in which the material to be treated passes. The gas mixture is exhausted by means of suction outlets which are associated with each gas distributor blade and are located in the side wall of the treatment chamber. The treated material is discharged at the bottom of the treatment chamber.

*Patents, *Sludge, *Solid wastes, *Waste treatment, *Byproducts, Biological treatment, Equipment, Design criteria, Fertilizers, Organic compounds

Compost

C077

SEWER WASTE WATER TREATING AGENT PRODUCED FROM WASTE CRACKING CATALYST,

Sanga, S., and Nishimura, Y.

Catalysts and Chemicals Industries Company, Limited,
Tokyo, Japan. (assignee)

United States Patent 3,960,760. Issued June 1, 1976. Official Gazette of the United States Patent Office, Vol. 947, No. 1, p 317-318, June, 1976.

A patent for a process that produces a powder useful for removing ammonium ions and heavy metal ions from waste water is described. Waste silica-alumina catalyst particles are utilized as the starting material. The method involves soaking catalyst particles previously used in a fluid-bed catalytic cracking unit in an aqueous sodium hydroxide solution (0.2-0.5 normal concentration) at a temperature between 70 and 105 C for from 2-48 hours. Anywhere between 50-100 milliliters of sodium hydroxide solution is used per 10 grams of waste catalyst particles treated. The catalyst particles are then removed from the sodium hydroxide solution and are washed and dried to obtain a powder useful for treating waste water.

*Patents, *Waste water treatment, *Ammonium salts, *Heavy metals, *Byproducts, Catalysts, Ions, Chemical wastes, Industrial wastes

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C078

METHOD AND APPARATUS FOR TREATING LIQUID SEWAGE AND WASTE,

Lebo, W. R.

United States Patent 3,960,718. Issued June 1, 1976. Official Gazette of the United States Patent Office, Vol. 947, No. 1, p 306, June, 1976. 1 fig.

A patent for a process designed to treat liquid waste containing sewage and/or manure such that the liquid can be used as a plant nutrient and soil conditioner is described. The liquid waste is fed into a cone-shaped pressure vessel into which a stream of pressurized oxygen-containing gas is injected. The oxygen injection is designed to impart a centrifugal motion to the liquid waste and impinge against the solids in the liquid with sufficient force to break the solids into small particles. The oxygen-containing gas also thoroughly aerates the liquid material and pressurizes the vessel such that the pressure above the liquid in the vessel is between 4 and 15 pounds/sq in. Sulfuric acid is then injected into the liquid material so that the material's pH can be adjusted to 3.0 or less for the purpose of sterilization; the pH is then readjusted to between 6-7. The gas pressure above the liquid level in the vessel is then allowed to cause the discharge of the liquid material from the vessel onto a compost material such as sawdust, ground bark, peat-moss, straw, or wood chips.

*Patents, *Waste water treatment, *Aeration, *Organic wastes, *Byproducts, Nutrients, Fertilizers, Sewage treatment, Oxygenation

C079

COMPOSITIONS FOR TREATING DOMESTIC AND INDUSTRIAL LIQUID WASTES,

Chappell, G. M.

Chemlan Company, Incorporated,
Biddeford, Maine. (assignee)

United States Patent 3,963,637. Issued June 15, 1976. Official Gazette of the United States Patent Office, Vol. 947, No. 3, p 1270, June, 1976. 1 fig.

A patent for an acid formula composition used in flocculating industrial, domestic, and municipal liquid wastes is described. The composition consits of the following components: 30-98% (by weight) of aluminum sulfate; 2-20% (by weight) of an alkali metal chloride; 0.0005-0.1% (by weight) of sodium or potassium hypochlorite; 10-25% (by weight) of an inorganic acid consisting of phosphoric, hydrochloric, sulfuric, or nitric acid; and 1-25% (by weight) of an organic acid consisting of oxalic, formic, acetic, or lactic acid.

*Patents, *Flocculation, *Waste water treatment, Industrial wastes, Domestic wastes, Municipal wastes, Organic compounds, Inorganic compounds

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C080

INTEGRAL CIRCULAR WASTEWATER TREATMENT PROCESS,

La Clair, L. M., McWhirter, J. R., and Ross, W. L.

Union Carbide Corporation,
New York, New York. (assignee)

United States Patent 3,963,609. Issued June 15, 1976. Official Gazette of the United States Patent Office, Vol. 947, No. 3, p 1261, June, 1976. 1 fig.

A patent for a process to reduce the biochemical oxygen demand of waste water is described. The process involves aeration with at least 50% oxygen in the presence of recycled activated sludge to achieve biological oxidation and biochemical oxygen demand reduction. The oxygen feed gas, waste water, and activated sludge are mixed in a first aeration zone wherein a fluid is simultaneously recirculated; and the partially oxygenated liquor as well as the gas which is partially depleted of oxygen are then separately introduced into a second aeration zone for continuous mixing and fluid recirculation. The further oxygenated liquor from the final aeration zone which has a reduced biochemical oxygen demand is separated into effluent water and activated sludge in a clarification zone, with at least part of the sludge being returned to the first aeration zone for recycling.

*Patents, *Waste water treatment, *Biochemical oxygen demand, *Aeration, *Activated sludge, Biological treatment, Design criteria, Oxidation, Recycling, Oxygen, Separation techniques

C081

APPARATUS AND PROCESS FOR PRODUCING AN ORGANIC PRODUCT FROM SEWAGE SLUDGE,

Hampton, Q. L.

United States Patent 3,963,471. Issued June 15, 1976. Official Gazette of the United States Patent Office, Vol. 947, No. 3, p 1223-1224, June, 1976. 1 fig.

A patent for a process which produces an organic product from sewage sludge is described. The process consists of the following steps: mixing a predetermined quantity of liquid waste sewage sludge with a chemical for coagulating or flocculating the solids contained in the liquid sludge, subjecting the mixture to pressure for the extraction of a portion of the moisture, draining off the extracted moisture, heat drying and pelletizing the detwatered material to produce pellets, subjecting the dry pelletized material to a suction action in order to separate dust and fine particles from the pellets, and discharging the separated pellets by gravity to a storage location. In addition, a portion of the pellets produced are mixed with the dewatered material for drying and preheating prior to the heat drying and pelletizing stages so that the drying temperatures can be selected low enough to prevent formation of clinkers and the ignition of organic material.

*Patents, *Sewage sludge, *Organic compounds, *Sludge treatment, *Byproducts, *Waste treatment, Coagulation, Flocculation, Separation techniques, Dewatering, Temperature, Recycling

C082

PROCESS FOR TREATING DECOMPOSABLE ORGANIC WASTE MATERIALS,

Haug, L. A.

United States Patent 3,963,470. Issued June 15, 1976. Official Gazette of the United States Patent Office, Vol. 947, No. 3, p 1223, June, 1976.

A patent for a process that treats decomposable wet sewage sludge in order to produce a partially dry humus-like material is described. The process involves partially drying a portion of the wet material, spreading this portion in the form of an absorbent pad, mixing an additional quantity of sewage sludge with the first portion in order to produce a mixture having an initial moisture content sufficient for the initiation of aerobic decomposition, and periodically turning the mixture under ambient atmospheric conditions in order to aerate it until decomposition ceases and the mixture is partially dry. The steps of wet material addition and aeration (periodic turning) are successively repeated, and a portion of the partially dry humus-like material is removed from the partially dried mixture at predetermined intervals.

*Patents, *Sewage sludge, *Organic compounds, *Sludge treatment, *Byproducts, Aeration, Biological treatment, Absorption, Decomposing organic matter, Waste treatment

C083
WASTE-WATER PURIFICATION,

Knopp, P. V., and Gitchel, W. B.

Sterling Drug Incorporated,
New York, New York. (assignee)

United States Patent 3,957,632. Issued May 18, 1976. Official Gazette of the United States Patent Office, Vol. 946, No. 3, p 1227, May, 1976. 1 fig.

A patent for a process that simultaneously removes organic carbonaceous material from waste water and converts reduced nitrogenous forms to elemental nitrogen is described. The process involves the following steps: feeding the waste water into a vessel containing a developing active biomass having a sludge age of at least three days, introducing an aqueous suspension of powdered activated carbon and a non-condensible oxygen-containing gas to the vessel, maintaining aerobic conditions for at least one hour so that ammoniacal nitrogen is oxidized to nitrite or nitrate, settling and separating the activated carbon associated and adsorbed organic material as well as the biological solids and returning the solids to the inlet end, passing the liquid phase from the last step to an anaerobic zone containing denitrifying organisms, adding additional activated carbon and a source of organic carbon to the anaerobic zone so that the oxidized nitrogen forms are reduced to elemental nitrogen while solids accumulate, passing the mixture from the last stage to a quiescent zone where the activated carbon and associated organic material are removed from the waste water, and removing the effluent from the quiescent zone.

*Patents, *Waste water treatment, *Biological treatment, *Anaerobic conditions, Organic compounds, Nitrogen compounds, Activated carbon, Adsorption, Denitrification, Separation techniques, Oxidation, Reduction (chemical), Sludge

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C084
IMPROVEMENTS IN AND RELATING TO WASTE WATER TREATMENT,

Barnard, J. L.

The South African Inventions Development Corporation,
Pretoria, South Africa. (assignee)

United States Patent 3,964,998. Issued June 22, 1976. Official Gazette of the United States Patent Office, Vol. 947, No. 4, p 1722-1723, June, 1976. 1 fig.

A nitrogen removal process for organic waste water containing nitrogenous compounds was patented. Waste water and activated sludge recycled from a subsequent stage are fed to the first biological denitrification stage. Turbulence is induced to mix the activated sludge and waste water, producing a mixed liquor. Heterotrophic bacteria suspended in the activated sludge convert nitrates into nitrogenous gases under anoxic conditions. Mixed liquor from this stage passes to the second stage, which is aerated to maintain a dissolved oxygen concentration between 0.2 and approximately 6 mg/liter. Nitrifying activated sludge bacteria biologically nitrify nitrogenous compounds, producing nitrates. Mixed liquor containing nitrates formed in this stage is recycled to the first stage at a daily average of at least 0.8 times the first stage feed rate, by volume, of waste water. The mixed liquor residence time in the first stage is sufficient to denitrify 80% by weight or more of the recycled nitrates. Mixed liquor is passed from the nitrification stage to another stage where turbulence is induced, and mixed liquor residence time is sufficient for endogenous bacterial respiration to reduce oxygen and then convert 60% by weight or more of the nitrates to nitrogen gas. Mixed liquor is then passed to a solids separation stage to produce an activated sludge with a concentrated bacteria suspension and a clarified effluent. Clarified effluent is withdrawn from the separation stage.

*Patents, *Waste water treatment, *Biological treatment, *Activated sludge, *Nitrogen, Organic wastes, Nitrogen compounds, Denitrification

C085

APPARATUS FOR BIOLOGICAL PURIFICATION OF AN EFFLUENT,

Kaelin, J. R.

United States Patent 3,965,009. Issued June 22, 1976. Official Gazette of the United States Patent Office, Vol. 947, No. 4, p 1726, June, 1976. 1 fig.

An apparatus was patented for biologically purifying an effluent. It includes two identical basins which are sealed gas-tight at their top portion and have a common wall. This common wall has through passages interconnecting the basins. The effluent being purified is fed alternately to each basin. The purified water is then discharged alternately from each basin. When the concentration of activated sludge in one basin falls below a specified level, the operation changes direction; the other basin serves as the activated sludge basin and the first basin serves as a final purification basin. An aeration impeller is provided for enriching the effluent with oxygen or a mixture containing oxygen and for agitating the effluent in the basin functioning as the activated sludge basin. The impeller is double-sided and has a supply line for oxygen that extends into one of its intake openings. A slide that is vertically movable is provided in the upper part of the common wall to open and close a passage in its upper end. Rails and rollers are provided to reciprocally support the aeration impeller on the basins and to slidably move the aeration impeller through the movable passage between the basins. Excess oxygen is removed from the upper part of the basins.

*Patents, *Waste water treatment, *Biological treatment, *Activated sludge, *Treatment facilities, Effluents, Equipment, Basins

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C086

SEWER LAYING SYSTEM,

Brown, W. R.

United States Patent 3,956,901. Issued May 18, 1976. Official Gazette of the United States Patent Office, Vol. 946, No. 3, p 994, May, 1976. 1 fig.

A patent for a tile carrying and service device used for laying sewer systems is described. The device consists of the following components: a chassis with wheels, pipe handling bays situated on each side of the chassis, platforms in the pipe bays for support of the tiles, a means for conveying the tiles which are discharged transversely from the pipe bay platforms to a point distally from the chassis, a lift means for the platforms, and a means for discharging individual tiles from the pipe bays.

*Patents, *Construction equipment, *Sewers, *Pipelines, *Tiles, Conduits, Conveyance structures, Engineering structures

C087

SEWAGE TREATMENT METHOD AND APPARATUS,

Gatti, G., and Fries, H.

ITT Industries, Incorporated,
New York, New York. (assignee)

United States Patent 3,957,633. Issued May 18, 1976. Official Gazette of the United States Patent Office, Vol. 946, No. 3, p 1228, May, 1976. 1 fig.

A patent for a device and method used for treating sewage water is described. The device consists of the following components: a sewage tank with inlet and outlet pipes; a pump with an inlet and outlet (inlet is submerged in the sewage water); a conduit connected at one end to the pump outlet and terminating at its other end in a movable discharge outlet adjacent but spaced apart from the tank outlet pipe; a sewage aeration means which includes an air intake pipe connected to the conduit and has an inlet outside of the tank; a means for moving the discharge outlet between a position aligned with the outlet pipe and a position where the discharge outlet is directed away from the outlet pipe; and a means for controlling the position of the discharge outlet.

*Patents, *Sewage treatment, *Aeration, *Equipment, Pumps, Pipes, Conduits, Design criteria, Waste treatment

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C088

AGGREGATION TREATMENT APPARATUS FOR WASTE WATER,

Motozawa, S., Itoga, H., Wada, H., and Marukawa, H.

Tokyo Denki Kagaku Kogyo Kabushiki Kaisha,
Tokyo, Japan. (assignee)

United States Patent 3,970,562. Issued July 20, 1976. Official Gazette of the United States Patent Office, Vol. 948, No. 3, p 1103, July, 1976. 1 fig.

A patent for an apparatus capable of aggregating suspended colloidal solids in waste water is described. The device consists of the following sections: a suspending stage in which metallic particles of metal, metal oxide, or sintered metal oxide carrying an electrical charge opposite to that on the solids in the waste water are suspended in a feed flow of the waste water; an electrical aggregating stage in which the feed flow with suspended particles is passed between oppositely charged electrodes to flocculate oppositely charged particles and colloidal solids; and a separating stage in which the metallic particles are separated from the flocculant-containing water. The suspending and separating stages are formed as an integral unit having an inverted conical upper section and a means for introducing the flocculant-containing flow from the aggregating stage in a tangential direction adjacent to the upper end. A means for removing the collected flocculated matter and effluent water from an interior point of the conical section is also provided.

*Patents, *Waste water treatment, *Flocculation, *Separation techniques, *Suspended solids, Equipment, Design criteria, Electrodes, Aggregates, Colloids, Metals

C089
SEWAGE SYSTEM,

Brennan, B. E.

United States Patent 3,972,650. Issued August 3, 1976. Official Gazette of the United States Patent Office, Vol. 949, No. 1, p 203-204, August, 1976. 1 fig.

A patent for a preassembled sewage collection unit designed for connection between a sewage source and a sewage discharge system is described. The sewage collection unit includes: a container having sewage inlet and outlet openings, each associated with a check valve; an air inlet connection and an air vent; a multi-stage valve assembly mounted within the upper portion of the container and connected to the air inlet and air vent; a cam which can be shifted between two limit positions and can be engaged by a pilot valve actuator; a float which can be shifted in response to the level of sewage in the container; and a quick-throw mechanism in the container which is responsive to variations in the level of the float for shifting the cam from one limit position to the other. The multi-stage valve assembly includes a pilot valve connected to the air inlet, a first pneumatically actuated valve connected to the air inlet and responsive to actuation of the pilot valve, and a second pneumatically actuated valve responsive to actuation of the first pneumatically actuated valve for discharging compressed air into the upper portion of the container.

*Patents, *Sewage treatment, *Hydraulic equipment, *Design criteria, Valves, Sewage, Equipment

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C090
ELECTROCOAGULATION SYSTEM FOR REMOVING POLLUTANTS FROM WASTEWATER,

Ramiriz, E. R.

Swift and Company,
Chicago, Illinois. (assignee)

United States Patent 3,969,245. Issued July 13, 1976. Official Gazette of the United States Patent Office, Vol. 948, No. 2, p 657, July, 1976. 1 fig.

A patent for an electrocoagulation method capable of removing pollutants from raw waste water is described. The method consists of the following steps: providing a bubble supply produced electrolytically by decomposing a flow of waste water; positioning the bubble supply as a cylindrically shaped dense zone of fine bubbles in a direction longitudinal to the flow of waste water; rapidly flowing the waste water through the dense zone of fine bubbles; turbulently contacting the fine bubbles with pollutants in the waste water to form a buoyant embryo floc within the waste water; venting the dense bubble zone to the atmosphere to prevent pressure buildup within the zone; removing the unseparated flow of waste water and embryo floc from the dense bubble zone such that some of the buoyant embryo floc is combined into a buoyant full floc; introducing the full floc and waste water into a downstream flotation basin such that the buoyant full floc rises to near the surface of the waste water in a manner approximating a laminar flow; and then clarifying the waste water by separating the full floc from the waste water.

*Patents, *Waste water treatment, *Separation techniques, *Coagulation, *Electrolysis, Bubbles, Flocculation, Waste treatment

*Electrocoagulation

C091
TANK CLARIFICATION PLANT,

Kaelin, J. R.

F. B. Rice and Company,
Balmain,
New South Wales, Australia.

Australian Patent 472,050. Issued May 13, 1976. Australian Official Journal of Patents, Trade Marks, and Designs, Vol. 46, No. 16, p 1546-1547, May 13, 1976.

A patent for a tank clarification plant designed for handling large-scale irregular sewage influx is described. The device consists of the following components: a tank; a liquid circulation member disposed adjacent the lower region of the tank and in the central area thereof; several impeller blades associated with the circulation member for causing liquid in the tank to circulate in a direction from above the impeller blades to the upper level of the liquid in the tank; at least one stationary cutting blade disposed immediately adjacent the liquid circulation member and having leading edges continuously cooperable with the impeller blades of the circulation member for producing a shearing effect therebetween; a conduit in the tank which is open at one end to the exterior of the tank and at the other end immediately above the liquid circulation member for the purpose of introducing oxygen or an oxygen-containing gas mixture into the immediate vicinity of the inlet side of the liquid circulation member; and a means for controlling the liquid level in the tank to insure that the liquid level is always above the liquid circulation member.

*Patents, *Flow, *Sewage treatment, *Waste water treatment, *Equipment, *Design criteria, Water levels, Oxygenation, Separation techniques

C092
SLUDGE ELEVATOR FOR FLUID CLARIFICATION SYSTEM,

Zaenkert, F. A.

Cincinnati Butchers' Supply Company,
Cincinnati, Ohio.

United States Patent 3,966,617. Issued June 29, 1976. Official Gazette of the United States Patent Office, Vol. 947, No. 5, p 2252, June, 1976. 1 fig.

A patent for a fluid clarification device designed to separate scum, sludge, and clear fluid from contaminated effluent is described. The device consists of the following components: a separator tank with a rotatable shaft which extends axially for the entire height of the tank; an inlet pipe extending upwardly into the tank from the bottom thereof and having an effluent discharge opening for discharging contaminated effluent within the tank; a cylindrical housing disposed coaxially around the inlet; a circular splash plate located above the discharge opening and connected to the rotatable shaft; a circumferential channel defined by an outer side wall and an inner wall, with the bottom edge of the inner wall spaced upwardly from the bottom a distance greater than the maximum depth of sludge accumulation on the tank bottom so as to define a fluid discharge port for clean effluent; a skimmer means for sweeping floatable particles from the fluid surface; and a scraper blade for removing settled particles from the tank bottom. The circumferential edge of the splash plate defines several radially and downwardly directed ports for directing the flow of contaminated effluent impinging against the plate from the inlet discharge opening in an outward and downward direction into the tank at a level below the liquid surface.

*Patents, *Waste water treatment, *Separation techniques, *Equipment, *Design criteria, Liquid wastes, Waste treatment, Sludge

C093
DOUBLE FUNNEL DEVICE FOR OXYGENATING SEWAGE,

Romanowski, J. W.

Atara Corporation,
Quebec, Canada.

United States Patent 3,968,086. Issued July 6, 1976. Official Gazette of the United States Patent Office, Vol. 948, No. 1, p 261, July, 1976. 1 fig.

A patent for a device designed to oxygenate liquid sewage is described. The device consists of the following components: a means for supplying a pressurized oxygen-containing gas which includes an orifice for issuing a continuous stream of gas upwardly from below the top surface of the liquid sewage; a means for securing a first funnel at a location downstream from the orifice, with the upstream opening of the first funnel comprising a first inlet for entraining liquid sewage; a second funnel extending downstream from the downstream opening of the first funnel; a means to secure the second funnel in a predetermined relationship to the first funnel, with the upstream opening of the second funnel comprising a second inlet for entraining liquid sewage; an exit tube extending both upstream and downstream from the downstream opening of the second funnel, with an upstream opening in the exit tube which comprises a third inlet for liquid sewage entrainment; and a means for securing the exit tube to the gas supplying means.

*Patents, *Sewage treatment, *Oxygenation, *Equipment, *Design criteria, Waste treatment, Liquid wastes

C094
METHOD OF TREATING WASTE WATER,

Liles, A. W., and Schwartz, R. D.

Exxon Research and Engineering Company,
Linden, New Jersey.

United States Patent 3,968,036. Issued July 6, 1976. Official Gazette of the United States Patent Office, Vol. 948, No. 1, p 248-249, July, 1976. 1 fig.

A patent for a process which biologically treats industrial and municipal waste water containing organic carbon is described which utilizes a catalyst which has been deactivated in a fluid cracking process. The method involves mixing the waste water with an activated sludge at conditions which promote the biological oxidation of a portion of the organic carbon present in the waste water. These conditions include operation at a temperature between 10 and 60 C and the separation of the effluent from the mixture of waste water and activated sludge. The novel aspect of the process involves the mixing of a catalyst with the activated sludge. The catalyst is one which has been deactivated in a fluid cracking process and comprises vanadium, iron, nickel, copper, and carbon supported on an inorganic oxide of alumina, silica, aluminum silicates, or mixtures thereof. The ratio of the inorganic oxide, which acts as a nucleation center in the process, to activated sludge is anywhere from 0.1 to 10 weight%.

*Patents, *Biological treatment, *Waste water treatment, *Activated sludge, *Catalysis, Industrial wastes, Municipal wastes, Byproducts, Carbon, Organic compounds, Oxidation, Nucleation, Oxides, Metals

C095

PROCESS AND APPARATUS FOR TREATING WASTES BY A COMBINED ACTIVATED SLUDGE AND BIOLOGICAL FILTER BED,

Tymoszczuk, J.

United States Patent 3,968,034. Issued July 6, 1976. Official Gazette of the United States Patent Office, Vol. 948, No. 1, p 248, July, 1976. 1 fig.

A patent for a biological process and apparatus designed to treat waste water and sewage is described. The process involves the following steps: maintaining a submerged aerated biological filter bed zone in which finely divided particulate filtering media circulate; maintaining an aerated activated sludge zone in an upstream fluid zone; feeding waste to the activated sludge zone; recycling the waste from the activated zone through the biological filter bed and back to the activated sludge zone; maintaining a biological stable filter bed zone in downstream fluid flow relationship to the aerated biological filter bed zone and activated sludge zone so that the waste passes thereto; draining the treated waste from the biological stable filter bed zone; and backwashing the biological stable filter bed zone as often as required to maintain the operating effectiveness of the filter and an acceptable headloss at the treated effluent withdrawal point.

*Patents, *Biological treatment, *Activated sludge, *Filtration, *Waste water treatment, Aeration, Sewage treatment, Recycling, Design criteria, Equipment

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C096

EMULSION POLYMERIZATION OF CATIONIC MONOMERS,

Morgan, J. E., and Boothe, J. E.

Calgon Corporation,
Pittsburgh, Pennsylvania.

United States Patent 3,968,037. Issued July 6, 1976. Official Gazette of the United States Patent Office, Vol. 948, No. 1, p 249, July, 1976.

A patent for a process that releases water from activated sewage sludge is described. The process involves the following steps: addition to the sludge of between 0.1 and 20 ppm of a cationic polymer which is prepared by forming an aqueous solution of between 5-95% by weight of dimethyl diallyl ammonium chloride and between 0.005 and 5 mole% based on the moles of dimethyl diallyl ammonium chloride of a copolymerizable polyunsaturated cross-linking monomer selected from methylenebisacrylamide, methyl triallyl ammonium chloride, or tetraallyl ammonium chloride; preparation of a water-in-oil emulsion of the aqueous solution in a water insoluble liquid containing a surfactant, with the water insoluble liquid being between 25 and 90% by weight of the total emulsion and the surfactant being 0.5% to 10% by weight of the total emulsion; heating the emulsion to a temperature sufficient to polymerize the monomers in the presence of a free radical polymerization initiator, with the free radical initiator being present in amounts varying from 0.0000001 to 0.1 mole/mole of dimethyl diallyl ammonium chloride; and filtering the sludge-polymer mixture.

*Patents, *Sludge treatment, *Dewatering, *Filtration, *Polymers, *Emulsions, Surfactants, Waste treatment, Chemical reactions, Solubility

C097

SEWAGE SYSTEM WITH REUSABLE FLUSH MEDIUM,

Claunch, R. W., Deane, T. N., Rogan, P. D. M., Powe, C. M.,
and Werner, M.

Chrysler Corporation,
Highland Park, Michigan. (assignee)

United States Patent 3,974,528. Issued August 17, 1976. Official Gazette of the United States Patent Office, Vol. 949, No. 3, p 866, August, 1976. 1 fig.

A patent for a system that separates sewage waste from a flush medium so that the medium can be reused is described. The system consists of the following components: a non-aqueous liquid flush medium with a specific gravity less than that of water; a separating tank for receiving and separating the sewage waste and flush medium; a flush medium outlet means positioned in the upper section of the separating tank; a first waste receiving tank connected to the lower waste containing section of the separating tank; and a waste outlet means positioned in the first waste receiving tank. The two outlet means insure that the retained volumes of waste are held at substantially constant levels in both tanks. An intermediate interface in the separating tank established between the floating flush medium and the waste remains at a constant level below the flush medium outlet even during the receipt of additional flush medium and sewage waste.

*Patents, *Sewage treatment, *Separation techniques, *Design criteria, *Reclamation, Waste treatment, Flow

Flush mediums

C098

APPARATUS FOR AEROBIC DECOMPOSITION OF SEWAGE,

Diggs, R. E.

United States Patent 3,966,604. Issued June 29, 1976. Official Gazette of the United States Patent Office, Vol. 947, No. 5, p 2247, June, 1976. 1 fig.

A patent for an apparatus that achieves aerobic, sludge-free decomposition of sewage and waste water is described. The device consists of several separate liquid-containing compartments, a rotatable and horizontally disposed hollow drum at least partially immersed in the liquid contained in the first of the compartments, a raw sewage feed pipe with a discharge end located in the interior of the drum, and air inlet means at the bottom of the first compartment, a bubble trapping means connected with the drum, and a flow control means associated with the compartments to effect a sequential flow of material through all of the compartments and the recycling of heavier particles. Sewage introduced into the drum contacts an irregular inner surface of the drum sides for agitation. Drum rotation is sufficient to cause particle fragmentation and subsequent passage of smaller particles through holes in the drum sides. At least some of the bubbles produced by the air inlet means contact fragmented particles, resulting in agitation, aeration, and enhanced aerobic decomposition.

*Patents, *Sewage treatment, *Waste water treatment, *Aeration, *Aerobic treatment, Flow, Aerobic conditions, Equipment, Bubbles, Waste treatment, Liquid wastes

C099
TREATING POLLUTED WATER,

Australian Patent 471,335. Issued April 1976. Official Journal of Patents, Trade Marks and Designs, Vol. 46, No. 13, p 1238, April, 1976.

A patent for a process to treat polluted water such that a disposable mass of solids is produced along with an effluent with a relatively low biochemical oxygen demand, low suspended solids level, and low phosphorus content is described. The method involves establishing a mixture of the polluted water with four additives: a bactericidal agent, a colloidal solids coagulating agent, a filter aid, and an absorbent. The aqueous medium has a solids particle size resulting from recirculation between a polluted water accumulation zone and a zone adapted to effect coarse disintegration of any solids exceeding a predetermined particle size. The mixture of polluted water and additives is passed through a liquid and airtight liquid flow system under conditions to effect an intimate mixing of the additives and to maintain the solids in suspension. The liquid portion of the suspension is then separated from the solids for discharge as a substantially solids-free effluent.

*Patents, *Waste water treatment, *Separation techniques, *Coagulation, *Absorption, Filtration, Bactericides, Suspended solids, Biochemical oxygen demand, Phosphorus, Waste treatment

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C100
TREATMENT OF SEWAGE,

Australian Patent 472,563. Issued May 27, 1976. Official Journal of Patents, Trade Marks and Designs, Vol. 46, No. 18, p 1749, May, 1976.

A patent for a method of treating sewage is described. The method involves the following steps: flushing the sewage with a flushing liquid from several receivers to form a mixture of liquid and sewage; separating the mixture into a portion containing a high level of solids and another portion containing a high level of liquid; separating the solid matter from the liquid with a high liquid content; maintaining a chemical composition in the liquid such that it acts as a disinfectant and deodorant; maintaining a bleaching action in the liquid to achieve a decolorizing effect; using the liquid as flushing liquid for the first step; subjecting the high solids portion of the waste to mechanical particle size reduction; and holding the high solids portion of the waste in storage so that substantially all of the solid matter is exposed to the chemical content of the liquid and is thereby broken down, dispersed, sterilized, and deodorized.

*Patents, *Sewage treatment, *Separation techniques, *Disinfection, *Color, Chemical reactions, Recycling, Waste treatment, Physical properties, Chemical properties

Deodorization, Decolorization

C101

DECANTING WASTE WATER,

Australian Patent 472,574. Issued May 1976. Official Journal of Patents, Trade Marks and Designs, Vol. 46, No. 18, p 1752, May, 1976.

A patent for a method of treating waste water and any flocculating agents which may be required is described which involves passing the liquid upwardly over a sludge bed. The liquid is introduced periodically through and across the surface of the base of the sludge bed, with the treatment time being very short relative to the pauses which follow them. The liquid is removed from the above sludge bed after treatment. The method offers improved settling characteristics over prior art methods by directing the liquid through a preferential current imparting means in a direction of flow inclined to the horizontal. The preferential current imparting means extends upwardly in the sludge bed from its base surface, thereby resulting in enhanced sludge settling in the bed and the generation of preferential currents in the liquid and sludge.

*Patents, *Waste water treatment, *Flow characteristics, *Separation techniques, Sludge, Currents (water), Waste treatment, Liquid wastes, Biological treatment

C102

METHOD OF WASTEWATER TREATMENT,

Torpey, W. N.

Autotrol Corporation,
Milwaukee, Wisconsin.

United States Patent 3,976,568. Issued August 24, 1976. Official Gazette of the United States Patent Office, Vol. 949, No. 4, p 1555, August, 1976. 1 fig.

A patent for a method of treating waste water containing settleable organic solids and solubilized carbonaceous pollutants is described. The method consists of the following steps: supplying the waste water to a treatment tank having upper and lower zones, settling the organic solids from the waste water in the upper zone, accumulating the settled solids in the lower zone, anerobically digesting the settled organic solids in the lower zone, and maintaining the waste water in the upper zone for a predetermined detention to produce a waste water effluent that is virtually free of dissolved or entrained hydrogen sulfide.

*Patents, *Waste water treatment, *Hydrogen sulfide, *Biological treatment, *Separation techniques, Organic compounds, Digestion, Waste treatment

C103

PHOSPHORUS REMOVAL FROM WASTE WATER,

Australian Patent 473,13[illegible]. Issued June 17, 1976. Official Journal of Patents, Trade Marks and Designs, Vol. 46, No. 21, p 2029-2030, June, 1976.

A patent for a method designed to treat waste water containing biodegradable carbonaceous pollutants and phosphorus compounds is described. The method involves the following steps: introducing the waste water into a first aeration zone where it is mixed with a carbon-food consuming sludge and a phosphorus-precipitating compound while being brought into intimate contact with an oxygenating feed gas; recycling the sludge settled from the effluent liquor to the first aeration zone; passing the solids-depleted liquid effluent into a second aeration zone where it is mixed with a carbon-food consuming sludge while being brought into intimate contact with a second oxygenating gas; and discharging the solids-depleted liquid effluent from the second aeration zone as product effluent water. The carbon-food consuming sludge in the second aeration zone consists at least in part of recycled sludge settled from the effluent liquor of the second aeration zone.

*Patents, *Waste water treatment, *Biological treatment, *Aeration, *Phosphorus compounds, Sludge, Chemical precipitation, Recycling, Oxygenation

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C104

METHOD FOR IMPROVING SEWAGE SLUDGE INCINERATION,

Flynn, G.

Nalco Chemical Company,
Oak Brook, Illinois. (assignee)

United States Patent 3,974,783. Issued August 17, 1976. Official Gazette of the United States Patent Office, Vol. 949, No. 3, p 951, August, 1976.

A patent for a method that improves sewage sludge incineration by lowering the ignition temperature of carbon is described. The method involves burning the sewage sludge in the presence of between 50-8000 ppm by weight (based on dry sewage sludge) of an additive consisting of a metal compound and a magnesium compound. The metal compound may contain copper, cobalt, manganese, iron, or calcium. The magnesium compound may be either magnesium oxide or any magnesium compound which decomposes to magnesium oxide under combustion conditions. The weight ratio of the magnesium compound (expressed as Mg) to the metal compound (expressed as said metal) is between the range of 5:1 to 35:1.

*Patents, *Sewage sludge, *Sludge treatment, *Sludge disposal, *Incineration, Temperature, Magnesium compounds, Metals, Waste treatment, Solid wastes, Carbon, Burning

Combustion

C105
APPARATUS FOR TREATMENT OF AQUEOUS SEWAGE COMPOSITION,

Johnson, T. C., and Snodgrass, J. D.

Heds, Incorporated,
Chagrin Falls, Ohio. (assignee)

United States Patent 3,975,256. Issued August 17, 1976. Official Gazette of the United States Patent Office, Vol. 949, No. 3, p 1105, August, 1976. 1 fig.

A patent for an apparatus capable of treating aqueous sewage without mechanical manipulation is described. The device consists of the following components: an enclosed chamber for receiving the aqueous sewage composition in its lower portion, thus defining an ullage space in its upper portion; a gas-tight valved inlet for the aqueous sewage which opens into the top of the ullage space; at least two electrodes of unlike polarity extending into a treatment space at the lower sewage-receiving portion of the chamber below the ullage space; a means for imposing on the electrodes a potential difference which is sufficient to effect an electrolytic discharge of gas at at least one of the electrodes as well as a current across the electrodes which is sufficient to cause an ebullient roiling action which in turn causes the generation of a solids-containing head of lesser density above the aqueous sewage composition; and an outlet from the top of the ullage space which is connected through a conduit to a discharge end and allows for the outward passage of the solids-containing head.

*Patents, *Sewage treatment, *Separation techniques, *Electrodes, Design criteria, Electrical equipment, Waste treatment, Electric currents, Equipment

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C106
TREATING SEWAGE AND RECOVERING USABLE WATER AND SOLIDS,

Stralser, B. J.

United States Patent 3,975,247. Issued August 17, 1976. Official Gazette of the United States Patent Office, Vol. 949, No. 3, p 1102-1103, August, 1976. 1 fig.

A patent for a process and apparatus that treats sewage and recovers usable water and solids which are substantially free of live bacteria is described. The method involves the following steps: diluting the sewage with water to greater than 20 parts of water to one part solids (by weight); macerating the diluted material; passing the diluted macerated sewage upwardly through a screen thereby separating the non-suspended solids from the liquid; adjusting the chloride salt content of the sewage to between a minimum of 0.05% and a maximum of 3.5% (by weight); passing the screened sewage in a serpentine path progressively between a series of parallel electrodes; removing the evolved gases as the sewage progressively passes between the electrodes; and separating the liquid and suspended solids after the sewage passes between the electrodes. The electrical current flow between adjacent electrodes and through the sewage is between 0.25 and 1.0 amperes/sq in of electrode surface.

*Patents, *Sewage treatment, *Separation techniques, *Electrical equipment, *Reclamation, Electrodes, Design criteria, Chlorides, Waste treatment, Electric currents, Bacteria, Suspended solids

D001

DECOLORIZATION OF NIGHT SOIL TREATMENT PLANT EFFLUENT BY OZONE
(Ozon ni yoru shinyo shorisui no dasshoku),

Kobayashi, T., Tachikawa, H., and Eto, Y.

Mizushori Gijutsu, Vol. 16, No. 11, p 1067-1073, November, 1975. 10 fig, 7 tab, 4 ref.

Tertiary treatment for the decolorization of domestic liquid wastes using ozone is described. Wastes which had received secondary treatment were used, and the color of the sample waste water ranged from 429 to 730. The waste water was treated in an aeration tank with bubbled ozonized air having a gas-liquid ratio of 15. By ozone flotation, up to 90% decolorization efficiency could be obtained. However, the removal efficiencies of COD, SS, and turbidity of the sample water were low, measured at a maximum of 45%, 50%, and 70%, respectively. Removal of COD and SS increased with increased ozone concentration; however, this increased ozone concentration raised the BOD level in the treated water. In order to have optimum ozone tertiary treatment, the use of coagulation before or after ozonization was necessary. Coagulation was found to be more economical before ozone treatment than after. The coagulation plus ozone tertiary treatment method gave removal efficiencies of 83.1%, 56.9%, 83.3%, and 87.6% for color, COD, turbidity, and suspended solids, respectively.

*Waste water treatment, *Ozone, *Tertiary treatment, Color, Chemical oxygen demand, Suspended solids, Coagulation

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D002

OZONIZATION OF WATER IN MOSCOW (OZONISATION DE L'EAU A MOSCOU),

Tverskoi, I.

La Nouvelle Presse Medicale, Vol. 5, No. 2, p 61-62, 1976.

A new drinking-water ozonization plant with a daily capacity of 1,200,000 cu m of water is being installed in Moscow by the French company Treillygaz. Ozonization is performed in two steps. First in a bath, ozone is admitted through porous ceramic tubes at a rate of 3 mg/liter of water for decolorization and the improvement of organoleptic properties. A second step follows conventional purification and filtration. This second step, operating at an ozone expenditure of one mg/liter, is used for disinfection.

*Potable water, *Ozone, *Disinfection, *Water treatment, Foreign research, Organoleptic properties, Color

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D003

MUNICIPAL WASTE WATER TREATMENT BY OZONE (Ozon ni yoru toshigesui shori),

Takusagawa, A., Matsumura, T., and Fukuzuka, T.

Gesuido Kyokaishi, Vol. 13, No. 140, p 51-58, January, 1976. 12 fig, 9 ref.

An ozone method has been studied for its decolorization, sterilization, and COD reduction effects, using tertiary treated sewage water. The COD removal efficiency was affected by the suspended solids concentration of the raw sample water. When sample water was filtered with a 3 micron pore filter paper, COD reduction with ozone treatment was about 23%; it was 48% when the sample water was filtered with one micron pore filter paper. Decolorization efficiency using the ozone treatment was very effective. A light yellow sample water could be completely decolorized by the ozone method in a short time, and the clarity of the treated water was comparable to that of drinking water. The degree of disinfection was determined by the number of coli group bacteria. No disinfection could be achieved with an ozone injection of 1.5 mg/liter water; however, nearly 100% of the coli group bacteria could be destroyed with an ozone injection of greater than 10 mg/liter water. A combination of ozone treatment with an electrolytic method and with an ultrasonic wave method were also studied for their effects on COD removal. The combination of ozone and ultrasonic waves did not increase the COD reduction efficiency. However, when ozone was injected between two electrodes during an electrolytic treatment, the COD reduction efficiency increased 1.5 to 2 times as compared to removal obtained with ozone alone.

*Ozone, *Waste water treatment, *Tertiary treatment, Disinfection, Chemical oxygen demand, Color, Coliforms

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D004

AN EXPERIMENTAL INVESTIGATION OF TERTIARY TREATMENT WITH A SUBMERGED FILTER (Sesshoku bakkiho ni yoru gesui sanjishori no jikkenteki kenkyu),

Masuda, S., Ishiguro, M., and Watanabe, Y.

Miyazaki Daigaku Kogaku-bu Kenkyu Hokoku, No. 21, p 19-25, 1975. 7 fig, 3 tab, 12 ref.

An investigation has been made of tertiary treatment for secondary treated sewage effluents. Some of the results obtained from a laboratory scale submerged filter unit operated on pretreated domestic sewage with activated sludge are described. The submerged filter consists of a bed of media through which the waste water passes with air in an upward direction. Nitrification of bacteria takes place on the surface of stones and charcoal, and long solids retention times are possible. This method provides a highly efficient means of removing BOD, PO4, and NH4-N from secondary treated domestic sewage. The influent BOD and NH4-N concentrations range from 18 to 34 and from 28 to 43 ppm, with the PO4 concentration averaging approximately 10 ppm. At a BOD loading of 0.56 kg/cu m/day of media, the unit achieved 75% removal of BOD to yield an effluent with 8 ppm BOD. At 0.05 kg/cu m/day NH4-N loading, 97% removal of NH4-N was obtained to yield an effluent with 1.7 ppm NH4-N. A subsequent denitrification experiment was performed in which only 0.5 hours contact time were needed to yield an effluent of zero ppm NO3-N at a 4400 ppm MLSS level.

*Filters, *Tertiary treatment, *Waste water treatment, Sewage treatment, Nitrification, Denitrification, Nutrient removal, Nitrogen compounds

Submerged filter

D005
REMOVAL OF WATER FROM SLUDGES WITH FILTER PRESSES
(SCHLAMMENTWAESSERUNG MIT PRESSFILTERN),

Alt, C.

Chemie-Ingenieur-Technik, Vol. 48, No. 2, p 115-124, February, 1976. 17 fig, 1 tab, 7 ref.

Filter presses have been used to decrease the residual moisture in certain sludge filter cakes. Several types of machinery, both batch and continuous, have proven efficient for this purpose. Others continue to be tested. A brief theoretical description, which permits some conclusions to be drawn regarding the process engineering problems involved, is provided. Some of the most important developments in sludge dewatering are also described.

*Sludge treatment, *Dewatering, Equipment, Filtration

*Filter presses

D006
ELECTRIC EQUIPMENT FOR MUKOGAWA SEWAGE TREATMENT PLANT, HYOGO
PREFECTURE (Hyogoken mukogawa shorijo no denki setsubi),

Yokomichi, K., Hatada, H., Takahashi, S., Machida, M., and
Shiraki, Y.

Toshiba Rebyu, Vol. 31, No. 1, p 37-43, January, 1976. 10 fig, 3 tab.

The Muskogawa Sewage Treatment Plant in Hyogo Prefecture, Japan, has been built to cope with deteriorating water quality due to sewage from homes and waste water from factories. Goals include improved treatment efficiency to preserve water quality, and automation of operation to effect manpower savings. Control has been centralized by instrumentation and processes have been automated by introducing control computers. The facilities have been designed to produce further qualitative improvement in treatment through computer control, adapting to the individual quality and quantity of water.

*Sewage treatment, *Computers, *Waste water treatment, Automation, Treatment facilities, Instrumentation, Water quality

D007

INSTRUMENTATION AND CONTROL FOR WATER WORKS (Suidosetsubi no keisoku to seigyo),

Omata, I., Hiroi, K., and Kawabe, K.

*Toshiba Rebyu, Vol. 30, No. 11, p 809-812, October, 1975. 7 fig.

The more modern water service systems in Japan have tendencies towards increases in scale, elimination of manpower, and more economical service. Scales of water works are being enlarged through the introduction of new monitoring instruments, telemeters, and process computers, both for intake and for distribution. Instrument control equipment has significantly increased in importance. A description is presented of the remote supervision system supplied by Toshiba to the Yokosuka Waterworks Bureau, as well as new techniques for monitoring and control of waterworks.

*Water works, *Water treatment, *Instrumentation, Equipment, Computers, Monitoring, Control systems

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D008

AMMONIA NITROGEN REMOVAL FROM WASTE WATER EFFLUENTS BY ZEOLITE ION EXCHANGE AND ELECTROLYSIS COMBINATION (Zeoraito ni yoru ionkokan-denkai no kumiawase ni yoru haisui karano ammonia-sei chisso jokyo),

Seiyama, T., Kitao, T., Hiasa, T., and Ishimaru, H.

Mizushori Gijutsu, Vol. 17, No. 2, p 135-147, 1976. 9 fig, 7 tab, 11 ref.

The electrolytic oxidation of ammonia nitrogen was studied in the treatment of waste water using a zeolite to exchange ammonia ions. The ammonia ion fixed on the zeolite was eluted by sodium chloride solution, and electrolysis of the eluted solution was performed. This solution was then used to regenerate the zeolite, following adjustment of the sodium ion concentration. The electrolytic cell used five bi-pole electrodes, each of which consisted of six platinum electroplated titanium plates, 30 mm x 50 mm x 2 mm in size. Chlorine, hydrogen chloride, and nitrogen oxides gases generated during the electrolysis were absorbed by the sodium hydroxide solution which could be used to adjust the sodium ion concentration of the zeolite regeneration solution. Either a neutral or an alkaline pH was desirable for the elution solution, and the solution pH decreased with the electrolysis. The pH adjustment for the zeolite regeneration solution (thus the elution solution) could also be achieved by the sodium hydroxide solution used to absorb the gases generated during the electrolysis. The NaCl concentration required for the elution solution was more than one normal due to the electrolytic efficiency. In an application of the system, secondary treated sewage was treated with a zeolite which removed 90% of the ammonia nitrogen from the sample water; the electricity required to oxidize ammonia nitrogen in the zeolite elution solution was determined to be 35 to 46 KWH/kg N.

*Electrolysis, *Oxidation, *Waste water treatment, Nitrogen compounds, Ammonia, Zeolite, Ion exchange

D009

RECLAMATION AND USE OF MUNICIPAL WASTE WATER (Toshi ni okeru seikatsu haisui no sai-riyo),

Ikehata, A.

Kagaku to Kogyo, Vol. 28, No. 11, p 807-811, November, 1976. 1 fig, 2 tab, 1 ref.

The reuse of municipal waste water in Japan is discussed. Although actual water purification techniques can regenerate water within the quality of drinking water specified by law, the present use of regenerated waste water for potable purposes is not likely. The use of regenerated water for non-potable purposes has also met with citizen objections because of an emotional response to using "dirty" waste water. Therefore, water reuse has been limited to industrial water. Techniques for the regeneration of municipal waste water include biological treatment, coagulation, adsorption, oxidation, and reverse osmosis for treating total organic compounds; biological treatment, ion exchange, ammonia stripping, and reverse osmosis for treating nitrogen and phosphorus compounds; coagulation, ion exchange, reverse osmosis, and electrodialysis for treating metals and inorganic compounds; and chlorine and ozone methods for disinfecting harmful microorganisms and viruses. These methods are being used to treat secondary treated sewage water for reuse.

*Water reuse, *Municipal wastes, *Waste water treatment, Industrial water, Biological treatment, Coagulation, Adsorption, Reverse osmosis, Ion exchange, Electrodialysis, Chlorination, Ozone

Ammonia stripping

D010

MUNICIPAL WASTE WATER TREATMENT BY ROTATING DISC METHOD (Kaiten enbaho ni yoru hisui shori),

Nakayama, K.

Yosui to Haisui, Vol. 18, No. 1, p 37-46, 1976. 25 fig, 22 ref.

Biological waste water treatment using a rotating disc process has several advantages, including simplicity of operation, flexibility with varying load of the input water, capability for advanced treatment of waste water, small electricity consumption for operating the system, and capacity for expansion of the existing system. BOD removal efficiency by the process decreases when the water temperature is less than 13 C. However, the efficiency does not change at temperatures between 13 and 30 C. The ideal pH for this treatment is between 6.5 and 8.5. The optimum rotation speed of the discs is 18 m/min for municipal waste water and 10 to 30 m/min for industrial waste water. Factors affecting nitrification in the rotating disc process are temperature, disc rotation speed, and dissolved oxygen content. Optimum conditions are the same as those in BOD removal efficiency. Nitrification is not affected if the dissolved oxygen content is greater than 0.5.

*Waste water treatment, *Biological treatment, Biochemical oxygen demand, Nitrification, Hydrogen ion concentration, Temperature, Dissolved oxygen concentration

*Rotating discs

D011

SPECIFIC POLLUTANTS IN URBAN WASTE WATERS AND THE EFFICIENCY OF THEIR PURIFICATION (Spetsificheskie zagryazneniya gorodskikh stochnykh vod i effektivnost' ikh ochistki),

Kostovetskiy, Ya. I., Rakhov, G. M., and Shteynberg, F. I.

Vodosnabzhenie i Sanitarnaya Tekhnika, No. 10, p 34-35, 1975. 1 fig, 2 tab.

Waste water samples collected in Donetsk, Chernigov, Krivoy Rog and Voroshilovgrad (USSR) were analyzed for specific organic and inorganic pollutants, and the efficiency of municipal biological waste water treatment plants in the elimination of these pollutants was studied. Phenols, cyanides, thiocyanates, and caprolactam were identified as the major specific organic pollutants. They were almost completely eliminated by biological purification. While tantalum, thallium, arsenic, tungsten, hafnium, indium, lithium, cadmium, cerium, and antimony were absent in all waste water samples, traces of scandium, gallium, niobium, bismuth, and lanthanum were found. Lead, barium, molybdenum, tin, copper, silver, zinc, nickel, zirconium, cobalt, strontium and chromium were ubiquitous. The rate of elimination in biological treatment plants was 30-75%; 80-100% for cobalt, 62-78% for tin and barium, and 40-50% for nickel and zirconium. Copper and silver passed the treatment plant in more or less unchanged concentrations. The efficiency of aeration basins and biological filters in terms of heavy metal elimination was about the same. Additional reduction of the concentration can be reached by final treatment in lagoons (by 10-25% for copper, silver and zirconium, and by 60% for chromium).

*Waste water treatment, *Biological treatment, Pollutant identification, Heavy metals, Phenols, Inorganic compounds, Organic compounds

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D012

LAMELLA SETTLING TANKS (LAMELLA-ABSETZBECKEN),

Colomb, P.

Gas-Wasser-Abwasser, Vol. 56, No. 1, p 43-46, 1976. 3 fig, 1 tab, 4 ref.

General theory of sedimentation, and the uses and advantages of lamellar decanters in drinking-water preparation and waste water treatment are described. Lamellar decanters have the advantage of having a large decanting surface in a limited space. They can operate at loads of up to 23 m/hour against 2.3 m/hour for conventional settling basins in drinking-water preparation. They can be used with or without flocculation. For waste water treatment, they are used as a final step, operating at a load of about 15 m/hour relative to the free water surface. In case of coprecipitation, the flocculant is added after primary treatment for sludge separation in the lamellar decanter. The rates of BOD5 and phosphorus elimination are 70% and 90%, respectively. In case of precipitation after biological purification, the rate of elimination amounts to 90% for both BOD5 and phosphorus. Chemical treatment is necessary for efficient phosphorus elimination. Lamellar decanters are highly efficient in the separation and recovery of useful materials from industrial waste waters, including those from the pulp and paper industry, metal pickling, foundries, and metallurgical plants.

*Sedimentation, *Waste water treatment, *Water treatment, Settling basins, Separation techniques, Equipment, Potable water, Industrial wastes

*Lamella settling tanks

D013

SLUDGE STERILIZATION BY GAMMA RAYS (LA STERILIZZAZIONE DEI FANGHI CON RAGGI GAMMA),

Inquinamento, Vol. 17, No. 11, p 51-52, November, 1975.

In order to eliminate pathogens from sludges, a new treatment process has been developed based on ionizing irradiation of the bacteria and parasites. The facility consists of an irradiation pit with a central tube where the sludge is moved around during treatment, a processing system with circulation, and an aspiration pump, regulatory mechanisms, and pipes. Operations are discontinuous and full automatic. Irradiation improves the dewaterability of the sludge; with sedimentation alone, it is possible to remove at least half the water content of the sludge. The process does not consume oxygen and does not release gas or organic nitrogen compounds. The simple structure and functioning of the installation require only 30 minutes of human control per day.

*Sludge treatment, *Gamma rays, *Irradiation, Pathogenic bacteria, Disinfection

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D014

WASTE WATER PURIFICATION PLANT UHWIESEN-DACHSEN (ABWASSERREINGUNGSANLAGE UHWIESEN-DACHSEN),

Schweizerische Bauzeitung, Vol. 93, No. 45, p 719-722, November, 1975. 6 fig.

The new biological waste water treatment plant Uhwiesen-Dachsen (Switzerland) is described. After the separation of floating objects, sand and fats are separated in an aerated basin. The treatment facility is composed of an aeration basin and of a sludge settling basin, and a third stage is provided for the coprecipitation of phosphates by means of metal salts. Sludge is fermented, first anaerobically at 33 C, and then in an aerobic fermenter. The gas released in this process is used for heating various units of the waste water treatment plant.

*Waste water treatment, Biological treatment, Treatment facilities, Aeration, Settling basins, Anaerobic digestion, Sludge treatment

Aerobic digestion

D015

MEASUREMENT OF THE OXYGENATION CAPACITY IN WASTE WATER TREATMENT PLANTS USING COMPLETELY MIXED ACTIVATED SLUDGE (MESURE DE LA CAPACITE D'OXYGENATION DANS LES STATIONS DE TRAITEMENT A BOUES ACTIVEES EN MELANGE INTEGRAL),

Boutin, P., Vachon, A., Bechac, J. P., and Lopez, B.

Techniques et Sciences Municipales--L'Eau, No. 1, p 493-501, November, 1975. 6 fig, 5 tab, 16 ref.

In order to determine the oxygenation capacity of activated sludge treatment plants, the aeration and recycling processs were interrupted to allow the dissolved oxygen content to drop to 0 mg/liter through respiration of the microorganisms. Aeration was periodically resumed for short periods of time to maintain the homogeneity of the sludge and to avoid decantation. When the oxymeters indicated values close to 0 mg/liter, the procedure was begun. A volume of sludge was removed equal to the capacity of the pilot aeration installation and was deposited in it. Biological phenomena were blocked, in particular respiration, by adding a bacterial toxin such as a solution of copper sulfamate. Oxygen concentration was noted in terms of time. The oxymeter indicated a stationary value when the saturation concentration had been reached. The oxygen was then chemically determined according to the Winkler method. Aeration in the activated sludge vat was determined at the same time. Interpretation consisted of measuring at various points the slope of the curve on the basis of $p = K(Cs-C)$ to the R power where p is slope, R is respiration, K is aeration coefficient, Cs is saturation concentration, and C is concentration of the liquid. Since nominal conditions are usually not identical to experimental conditions, it was necessary to utilize corrective factors in terms of waste water and pure water, the initial temperature at the beginning of the process and the standard 10 C, and the experimental and normal atmospheric pressures.

*Activated sludge, *Dissolved oxygen, Oxygenation, Aeration, Respiration

D016

DISINFECTION OF URBAN SEWAGE SLUDGE (LA DESINFECTION DES BOUS RESIDUAIRES URBAINES),

Alexandre, D., Gevaudan, P., Charrel, J., Mallet, M. N., and Blancard, A.

Techniques et Sciences Municipales--L'Eau, No. 12, p 547-555, December, 1975. 6 fig, 7 tab, 16 ref.

A total of 134 sludge samples were taken from total oxidation treatment, aerobic treatment, and anaerobic treatment in order to compare the efficiencies of three disinfection processes: liming, tyndallization, and irradiation. Observations focused on typical fecal bacteria and experimentally added pathogenic agents such as mycobacteria and ascaris eggs at various stages of growth. Results indicate that with tyndallization, 47.7% coli bacilli and 53% streptococci resisted, 83% mycobacteria survived, and clostricium spores increased in number by a factor of 10. With liming, 0.34% coli bacilli, 0.63% streptococci, and 0.49% clostridium spores remained; the process did not affect ascaris eggs and mycobacteria. Gamma ray irradiation results varied according to the radiation dose. With 400 R, 2.22% coli bacilli, 2.36% streptococci, 33.8% clostridium spores, and 94% mycobacteria remained; with 800 R, 0.04-0.35% enterobacteria, 3% clostridium, and 0.4% mycobacteria survived. With 1,200 R, residual percentages were, respectively 0.0023, 0.007, 0.2, and 0%, and with 1,800 R, 0.0006, 0.0013, 0.002, and 0%. Irradiation could only destroy smooth-shelled embryonic ascaris eggs starting at 400 R. The source of the sludges did not seem to influence the efficacy of treatment. While liming was effective for sludges which did not contain hospital effluents, it cannot handle atypical mycobacteria which are epidemiologically significant.

*Sludge treatment, *Disinfection, Gamma rays, Irradiation, Lime, Pathogenic bacteria

Tyndallization

D017

APPLICATION OF CENTRIFUGES. DEWATERING OF SLUDGES FROM WATERWORKS (APPLICAZIONE DI CENTRIFUGHE. DISIDRATAZIONE DI FANGHI PROVENIENTI DA IMPIANTI DI POTABILIZZAZIONE),

Scorsa, M.

Inquinamento, Vol. 17, No. 11, p 49-51, November, 1975.

Sludges which accumulate at the bottom of sludge thickeners can be dewatered in centrifuges. The solids must be able to sediment while being centrifuged, and the sedimented solids must be transportable on a discharge cone located at the end of the centrifuge drum. Such conditions are achieved by injecting a polyelectrolyte solution at certain points outside and inside the centrifuge. Turbid waters containing 0.5 to 5% suspended solids can be centrifuged. A Sharples P. 3400 SDC centrifuge is capable of handling a production of 45,000 cu m/day of sludge, by working 24 hours a day and assuming that the sludge contains about 1.5% solids. The centrifuge takes up only 2.5 by 2 meters and weighs less than 2 tons. Results vary from installation to installation, but loads remain between 5 to 8 cu m/hour, with a product containing 15 to 30% dry solids and 2 to 5 kg of polyelectrolytes per ton. In all cases, over 95% of solids is recovered.

*Sludge treatment, *Dewatering, *Centrifugation, Equipment, Polyelectrolytes, Suspended solids

Centrifuges

D018

WASTEWATER RESEARCH FACILITY DESIGNED FOR COMPARATIVE TESTING,

Clough, C. F.

Water and Pollution Control, Vol. 114, No. 1, p 17, 30, January, 1976.

A pilot plant has been set up in Great Britain to evaluate advanced waste water treatment processes and equipment at a facility at the Coleshill Works of the Severn-Trent Water Authority. The Coleshill project is able to treat the waste in two separate complete water pollution control works in order to compare similar treatment methods. Sewage will be withdrawn from either or both of two sewers and industrial wastes may be added. Following preliminary screening and grit removal, flow control and balancing, the wastes will be passed to a movable treatment unit for advanced treatment. Reagents such as lime slurry or other flocculants are prepared in fixed equipment located near sludge dewatering facilities. The movable units will be used to experiment with types of treatment. Presently, the processes tested include liming, recarbonation, dual media filtration, and activated carbon.

*Waste water treatment, *Pilot plants, *Treatment facilities, Lime, Activated carbon, Flocculation, Sewage treatment

D019

CURRENT AERATION TECHNIQUES—AN OVERVIEW,

Water and Pollution Control, Vol. 114, No. 2, p 16-19, February, 1976. 1 tab.

An overview is presented of current aeration techniques for water and waste water treatment. The more common types of aeration equipment include: diffused aeration systems, submerged turbine aerators, and high- and low-speed surface aerators. Oxygen transfer occurs by generating the largest practical area of interface between a given liquid volume and air, preventing the build-up of thick interfacial films, and maintaining the highest possible driving force or concentration difference for adsorption and desorption. Most mass transfer applications in waste treatment are liquid-film controlled. An equation is provided to describe the oxygen transfer process, which involves the oxygen transfer coefficient, the oxygen saturation coefficient, the air-water interface and the volume of aerated liquid. Several procedures for testing aerators to determine equipment capabilities are available. The most widely accepted performance evaluation is the non-steady-state reaeration test. Any tests which compare different aeration devices must account for variations in physical and in chemical conditions. Various types of mechanical aerators, air diffusers, submerged turbines, and surface aerators are also described.

*Aeration, *Oxygen, Equipment, Kinetics, Evaluation, Performance, Waste water treatment, Water treatment, Reviews

D020

WASTEWATER RECYCLING UTILIZES PESKY NUTRIENTS,

Public Works, Vol. 107, No. 3, p 60-61, March, 1976.

A waste water treatment system being utilized at the Institute of Water Research at Michigan State University is described. The Water Quality Management Project (WQMP) facility includes a portion of the East Lansing sewage treatment plant, and will have the capacity of 2 mgd of waste water. The WQMP pumps waste water which contains large amounts of phosphorus and nitrogen to an area where it flows through each of four lakes. Solar energy powers photosynthesis in the lakes. Algae and rooted aquatic plants take up abundant supplies of the nutrients. The plants are harvested using a modified commercial aquatic weed cutter and special equipment similar to a rake. The typical algae harvested is Cladophora, used mainly for composting, and also for research on the possibility of feeding it to sheep. Dead algae, plankton, and other chemical compounds which settle to the bottom of the lakes are pumped and irrigated onto land. Bass have been stocked in the fourth lake and are reported to be thriving. Water from any of the four lakes may be applied to land by irrigation. Water not used for irrigation, but of a quality adhering to environmental standards, will be passed to the Red Cedar River.

*Waste water treatment, *Recycling, *Biological treatment, Sewage treatment, Treatment facilities, Equipment, Irrigation, Nutrients, Phosphorus, Nitrogen, Algae, Agriculture

Water Quality Management Project (WQPM), Land application

D021

POLLUTION CONTROL PLANT IS DESIGNED TO BE AN ATTRACTIVE NEIGHBOR, TOO,

Engineering News-Record, Vol. 196, No. 13, p 25, March 25, 1976. 2 fig.

A new municipal waste water treatment facility is being built in Austin, Texas, quite near a residential area. To overcome resistance to expansion at the site, plans for the new facility include landscaping the plant site, with the creation of buffer zones between the plant and its neighbors. About half of the 300-acre site will be given to the parks and recreation department for the creation of a golf course when the facility is complete in 1977. The rest of the site will accomodate expansion up to 150 mgd. With a combination of activated sludge and rapid sand filtration, the new plant is expected to produce effluent with 10 ppm BOD and 10 ppm suspended solids. The design calls for covering the facility's flow equalization and primary treatment basins and enclosing its grit removal equipment, as well as using activated carbon filters to remove odors.

*Treatment facilities, *Sewage treatment, *Waste water treatment, Texas, Activated sludge, Design, Filtration, Flow rates, Activated carbon

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D022

SLUDGE HANDLING AND DISPOSAL: A SPECIAL REPORT,

Pollution Engineering, Vol. 8, No. 1, p 22-33, January, 1976. 11 fig, 12 tab.

Methods of sludge dewatering and disposal are discussed. Initially, quantitative limits were applied to solids levels. Twenty to 24% was considered acceptable. Later, more qualitative limits were applied. Wastes take on the density and dewatering characteristics of their components. Treatment systems must be chosen for plants that do not yet exist. Two processes are available for the removal of water from sludges: concentration and dewatering. Advantages and disadvantages of various equipment are discussed. Organic polymers have shown much advantage in improving the settling of noncharged particles and in sludge dewatering. Gravity separation can be very useful for removal of suspended solids, primarily because of the free cost of separation energy. The main disadvantage is the large area required. Vacuum filtration depends upon atmospheric pressure acting on a vacuum. Several types are discussed. Additional equipment or processes may be needed to condition the sludge before they are ready for vacuum filtration. Design parameters for this method are discussed. Gravity belt filtration has been used for municipal sludges and is being studied for use in industrial sludges. This method is used on sludges in which polymers have been added for particle flocculation. Three different types of centrifuges for dewatering sludge are discussed: the solid bowl-scroll type; the imperforate basket type; and the disc-nozzle type. Plate and frame filtration is a batch process particularly adapted to filtration of solid slurries. Incineration is used for disposal of organic sludges. Sludge can also be used as fertilizer as long as the metal content is low.

*Sludge, *Sludge disposal, *Sludge treatment, *Dewatering, Treatment, Polymers, Filtration, Suspended solids, Vacuum drying, Incineration, Gravity, Centrifugation, Waste water treatment

Sludge dewatering, Gravity belt filtration

D023

PORTLAND ADDS SECONDARY TREATMENT,

Crom, J. A.

Stevens, Thompson and Runyan, Incorporated,
Portland, Oregon,
Environmental Engineering Division.

The American City and County, Vol. 91, No. 1, p 30-32, January, 1976.

Portland, Oregon, has been listed by the Environmental Protection Agency as one of the best places to live in the country. In the latest step to protect the water quality, a 42 million dollar program for water pollution control was implemented. A new 25 million dollar treatment facility will increase the efficiency of the plant from 30% to 90%. However, in attempting to operate at maximum efficiency and produce a high quality effluent, problems were encountered. Skill and experience of plant operators are important in achieving successful performance, so operator training plays a significant role in planning. The operation of the plant is discussed. Grit separation occurs in two stages. Grit and sludge are removed and separated by centrifugal grit removers. The amount of grit that was removed was well above the amount that was expected, and manual cleaning was required. A pre-grit removal section is planned. The secondary system uses a complete mix activated sludge process. Secondary clarifiers are of the vacuum sludge removal type. Return flows containing high strength organics are conditioned and equalized to avoid subjecting the aeration system to shock flows. The disposal of residuals or excess sludge is a difficult problem, especially with Portland's rainy climate. Disc centrifuges thicken the activated sludge to about 4.5% solids. It is dewatered on vacuum filters and disposed of in landfill. Other options are discussed. Incineration requires much energy and produces air pollution. Transportation to Oregon's dry inland plateau during the rainy winter has more potential. Problems still must be resolved before such a step is taken.

*Waste water treatment, *Treatment facilities, *Water quality, Oregon, Sludge disposal, Water pollution control, Activated sludge, Centrifugation, Training, Education, Personnel, Dewatering

*Secondary treatment, *Portland (Ore), Secondary clarifiers, Grit removal, Shock flows

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D024

MUNICIPAL WASTEWATER ODOR STILL A PROBLEM, PART 2,

Hartman, W. J., and Long, D. A.

Water and Sewage Works, Vol. 123, No. 1, p 52-54, January, 1976. 1 fig, 33 ref.

Recent research has shown that coliform organisms can become airborne in moisture droplets after irrigation of golf courses with raw waste water. Microbes in soils and on the surface of growing plants have a minimal chance of survival. By following strict safety measures, the contamination of residential areas adjacent to irrigation areas can be avoided. It is concluded that the irrigation of land by sewage is hygienically safe as long as the operation is in the hands of well organized and well run companies. Air pollution associated with waste water treatment and disposal is difficult and costly to control. The main problem of waste water treatment plants is odor control. The oldest method of odor control is chlorination. Chlorine will both oxidize and disinfect. It must be applied before sulfide generation begins, and this may be in some remote part of the sewer system. Other oxidants such as ozone, chromates, manganese dioxide, and chlorinated and brominated hydrocarbons are also effective for controlling odors, but they are also expensive. Some metallic ions will precipitate with sulfide and be toxic to certain growths to control odors. Nitrates and molecular oxygen prevent the reduction of sulfate to sulfite, to control odors. Odors associated with sludge disposal can be eliminated by combustion. Covers over various processes at a treatment plant will also reduce odors. Masking of odors is effective but costly. Microorganisms in the soil can reduce odors. Breaking up algae mats and the addition of pesticides will control odors in stabilization lagoons.

*Odor, Municipal wastes, Waste water treatment, Waste water disposal, Odor-producing algae, Chlorination, Microorganisms, Enteric bacteria, Bacteria, Sulfides, Treatment facilities, Air pollution, Chemical precipitation, Oxidation, Sludge disposal

D025
BASINGSTOKE SEWAGE TREATMENT WORKS, 1961-1975,

Axtell, R. J.

The Public Health Engineer, Vol. 4, No. 1, p 4-14, 22, January, 1976. 6 append.

The design of the present sewage treatment works at Basingstoke is discussed. The Works were designed in 1960 to treat sewage from a population of 80,000 people and from existing and new industrial areas. Present standards of effluent are 8 mg/liter biochemical oxygen demand and 10 mg/liter suspended solids with an ammonia limit of 2 mg/liter in the summer and 5 mg/liter in the winter. The inlet works consist of a 51 inch bitumen lined steel sewer and two mechanically raked screens. Grit is removed with a horizontal flow circular detritor. Two storm water tanks are provided and designed to work in series. Radial flow settlement tanks are used for primary sedimentation because of the greater ease in controlling flow distribution. Sludge is drawn hydrostatically but experiments have been conducted using pneumatic desludging. This has increased sludge concentration from 4% to 5%. Aeration with diffused air is used in the biological treatment. The retention time for Stage 1 is 7 1/4 hours Dry Weather Flow (DWF) and is increased to 8 1/2 hours DWF in Stage 2 in order to increase the degree of nitrification. Activated sludge was returned by means of four air lift pumps with poor efficiency. They were replaced with a variable speed bowl pump. The use of screw pumps is recommended in the future. Circular tanks are provided for secondary settlement. Walls are scraped with chains and the sludge is withdrawn hydrostatically. Microstraining was adopted for tertiary treatment. In Stage 1 heated sludge digestion followed by drying on open beds was adopted. Some problems encountered in sludge treatment are discussed.

*Sludge treatment, *Sewage treatment, *Treatment facilities, *Sewage, Sedimentation, Activated sludge, Sludge disposal, Aeration, Biological treatment

Basingstoke (England), Microstraining, Dry weather flow

D026
COATINGS FOR WASTEWATER TREATMENT PLANTS,

Berger, D. M.

Gilbert Associates, Incorporated,
Reading, Pennsylvania.

Public Works, Vol. 107, No. 2, p 68-70, February, 1976.

Water treatment and water pollution control plants must meet corrosion control demands rarely found in other types of construction. The choice of the proper coating should depend on the environment, the substrate being protected, the climate, and attractiveness. They must meet the requirements of an economical service life, reduced maintenance expenditures, and required decorative characteristics. Various materials are discussed. Coal tar epoxy works well on submerged concrete and metal. Zinc-rich primers protect steel in the same way that galvanizing does, can be easily applied, and the treated steel suffers less damage in transport. Vinyl copolymer solutions are most commonly used to provide color to submerged surfaces. Since the lead in lead based paints can react with hydrogen sulfide, chlorinated rubber based coatings are preferred. These types of coatings will also work well in rooms below ground level where moisture is a constant problem. Proper surface preparation is essential since any sort of dirt, moisture or grease can affect the adhesion of the coating. Steel must be cleaned of all rust, mill scale and surface contaminants. Sandblasting, centrifugal blasting or pickling are recommended procedures. Concrete must be aged at least 28 days under good conditions and should also be cleaned of surface contaminants. Spray application is the most preferred method because of its uniformity. Appropriate measures must be taken in confined spaces to provide fresh air and to avoid explosive solvent vapor air mixtures.

*Waste water treatment, *Treatment facilities, *Corrosion control, *Corrosion, *Coatings, Coal tar coatings, Zinc, Steel, Concrete plants, Lead, Cleaning

Coal tar epoxy, Rubber based coatings, Vinyl copolymer solutions

D027
WATER PLANT WASTE TREATMENT: STATE OF THE ART, PART II,

Fulton, G. P.

Public Works, Vol. 107, No. 2, p 57-60, 96, February, 1976. 2 fig.

The treatment of the waste element in water plant discharges is discussed. Present technology can come very close to accomplishing zero waste discharge. Only solids must then be removed from the water plant site. The major problem in the treatment of water plant wastes is the conditioning of sludge so that it is suitable for discharge at a reasonable cost. The lagoon is the most common waste treatment facility in use, serving as the all purpose method for treatment. The lagoon installation is inexpensive but it requires a large land area and difficulty arises in removing the sludge. Discharging wastes to the sewerage system can cause two major problems. The hydraulic elements may not be able to handle the shock load of discharges like filter backwash and the treatment plant may not be able to handle the solids loading. Dewatering of water plant waste solids in sludge drying beds can be very effective where the climate provides long periods of little or no rainfall. Natural freezing on open beds has also proven to be an effective means of dewatering, again where the climate permits. Mechanical dewatering devices such as the centrifuge, the belt press, and the filter press, have been utilized with some success. For all three devices, preconditioning of the sludge is required. It may be economically feasible for some plants to recalcinate lime from the treatment process. The big problem the water industry faces is that the best practicable control technology currently available does not provide reasonable solutions for all water plant waste treatment situations. Several trends that can be expected in the future are discussed.

*Waste water treatment, *Waste treatment, *Treatment facilities, *Water treatment, Sludge treatment, Lagoons, Dewatering, Cost analysis, Sewerage, Filtration, Centrifugation, Reviews

Zero discharge

D028
METHODS FOR FILTERING NITRIFIED EFFLUENTS,

Sampayo, F. F.

Jones and Henry Engineers,
Toledo, Ohio.

Water and Sewage Works, Vol. 123, No. 2, p 71-73, February, 1976. 4 tab.

Two case histories are presented on the determination of design parameters for filtering nitrified effluents produced from activated sludge or plastic media trickling filters. Data collected at Lima, Ohio, and at Sylvania, Ohio, are provided. Studies at both locations were conducted to determine the feasibility of effluent filtration. The current process at Lima consists of primary treatment, with activated sludge and plastic media trickling filters used for nitrification. For various filter rates, the influent and effluents were measured for BOD, suspended solids, and turbidity, with the average removals of BOD and SS recorded. Ammonia concentration in the influent and effluent were also measured. At Sylvania, where the present treatment includes chemical precipitation of phosphorus in primary treatment followed by activated sludge, data were collected on flow rates, influent and effluent turbidity, BOD, suspended solids, and COD. A comparison was also made of the length of filter runs versus headloss. The results of both studies indicated that: filtration of nitrified activated sludge or nitrification tower effluents presented no special problems; average filter rates, about 4.0 gpm/sf may be used for design; and, the ammonia concentration in the effluent is dependent upon the performance of the biological treatment processes, and is not related to the effectivenss of the filter design.

*Waste water treatment, *Design criteria, *Filters, *Nitrification, Ammonia, Data collection, Activated sludge, Biochemical oxygen demand, Chemical oxygen demand, Suspended solids, Flow rates, Effluents, Ohio, Treatment facilities

D029
STUDIES OF HIGH-RATE BIOLOGICAL TREATMENT OF IPSWICH SEWAGE ON
PILOT FILTERS USING PLASTICS MEDIA,

Banks, P. A., Hitchcock, K. W., and Wright, D. G.

Water Pollution Control, Vol. 75, No. 1, p 40-46, 1976. 2 ref.

High-rate biological filtration was investigated as a means of partially treating effluent to make it suitable to be discharged into an estuary. A pilot plant was used to study the new filter media, higher application rates, the nature and settlement of the sludge, the effects of varying the flow application frequency, and the required air access beneath the filters. Standards of 70 mg/liter suspended solids (SS) and 140 mg/liter biochemical oxygen demand (BOD) were proposed. Six biological filters which contain plastics could treat sewage at constant hydraulic loadings up to 10 cu m/cu m d with BOD loading as high as 3.5 kg/cu m d, producing an effluent with an average BOD between 70 and 80 mg/liter after settlement. The high-rate filter containing mineral media produced similar effluent quality operating at 4 cu m/cu m d hydraulic loading and 1.4 kg/cu m d BOD loading. The plastics media's specific surfaces did not affect the filter's BOD removal performance between 90 and 167 sq m/cu m. Treatment efficiency varied less with temperature than expected. The media characteristics did not affect the remaining SS concentrations in the filter effluents after quiescent settlement for 30 min. SS concentration averaged between 100 and 120 mg/liter, increasing slightly during spring. Modifications to the standard for SS have been considered. Surface dose rates of about 12 cu m/sq m d were satisfactory for distributions uniform enough to wet the top of the media adequately. High-rate filter performances were not affected by periodic liquid application at intervals of about 4 min. Full-scale high-rate biological filters containing high specific surface media can operate successfully without major provisions for ventilation.

*Filtration, *Waste water treatment, *Pilot plants, *Suspended solids, *Biological oxygen demand, Sewage treatment

*High-rate biological filters

D030
GRAVITY SEPARATION OF COARSE SOLIDS IN WASTEWATER,

Lodholz, J. C. and Pentz, H.

Public Works, Vol. 107, No. 3, p 76-78, March, 1976. 5 fig.

Equipment for removing coarse solids in pre-treatment operations is discussed. The normal purpose of such equipment is to minimize wear on mechanical equipment in the subsequent treatment steps. Most equipment for removing coarse solids is designed for removing 65 mesh material. Adjustable weirs can control velocity in long flow-throug grit chambers without aeration. The basis for designing aerated grit chambers is normally detention time. Coarse solids removal can affect the capability and effluent characteristics of the plant as a whole. Two inclined drag flight conveyor types may be used to handle heavy inorganic solids; the first has submerged sprockets, but only flights are submerged in the second. Aerated grit chambers are designed around other conveyor types, such as screw conveyors. Alternative methods of solids handling include scraper types in shallow settling tanks and cyclones in connection with screw washers. Monthly and yearly records should be kept of at least the volumes of coarse solids. Proper lubrication and maintenance of coarse solids removal equipment extends the life of other equipment in the plant.

*Solids removal, *Waste water treatment, *Separation techniques, Equipment, Pre-treatment, Maintenance

Gravity separation

D031

COSTS OF BIOLOGICAL WASTE WATER PURIFICATION (DIE KOSTEN DER BIOLOGISCHEN ABWASSERREINIGUNG),

Negaard, J.

Gas-Wasser-Abwasser, Vol. 56, No. 1, p 18-24, 6 fig, 2 tab, 1 ref.

Data from 50 Swiss sewage treatment plants were used to derive functional relationships between the construction and operating costs and their main parameters. For various costs, the combined effect of all important parameters may be determined by means of a multiple regression technique. This method has obtained much more reliable functions than those where only a single parameter is considered. By analysis of the cost relationships, some important conclusions concerning the construction and operating costs of sewage treatment plants can be drawn.

*Biological treatment, *Waste water treatment, *Treatment facilities, *Costs, Sewage treatment, Capital costs, Operating costs, Statistical methods, Regression analysis

*Switzerland

D032

TREATMENT OF WASTE WATER CONTAINING MERCURIALS BY ACTIVATED SLUDGE. I. MECHANISM REMOVAL OF MERCURIALS IN WASTE WATER (Kassei odei ni yoru suigin ganyu haisui no shori ni kansuru kenkyu. Kassei odei no suigin jokyo kiko),

Nakamura, K., Ito, J., and Dazai, M.

Kogyo Gijutsuin Biseibutsu Kogyo Gijutsu Kenkyusho Kenkyu Hokoku, No. 47, p. 49-57, December, 1975. 7 fig, 2 tab, 7 ref.

The mechanism occurring in the treatment of waste water containing mercurials was studied. Discontinuous treatment of waste water containing mercuric chloride by activated sludge proved satisfactory; mercury removal rates were over 99.8% in all cases. Volatilization also removed mercury. Using sludge acclimated to low concentrations (below 15 ppm) of mercuric chloride, the mercury concentration in the solution decreased rapidly after the addition of mercuric chloride. Within several hours, volatilization of mercury was almost complete, but at that time 1 to 3% per dry sludge weight mercury remained in the sludge. This mercury was volatilized after further addition of mercuric chloride. In activated sludge treatment, it was assumed that the use of mercury volatilization rate as the index of activity was appropriate for waste waters containing mercurials.

*Mercury, *Waste water treatment, *Activated sludge, Measurement

Volatilization, Index of activity

D033

TREATMENT OF WASTE WATER CONTAINING MERCURIALS BY ACTIVATED SLUDGE. 2. MERCURY VOLATILIZATION AND THE CAPACITY OF ACTIVATED SLUDGE FOR WASTE WATER CONTAINING MERCURIALS (Kassei odei ni yoru suigin ganyu haisui no shor ni kansuru kenkyu. 2),

Nakamura, K., Ito, J., and Dazai, M.

Kogyo Gijutsuin Biseibutsu Kogyo Gijutsu Kenkyusho Kenkyu Hokoku, No. 47, p 59-66, December, 1975. 10 fig, 1 tab, 3 ref.

Mercury removal in the treatment of waste water containing mercuric chloride by activated sludge has been studied. It was found that added mercuric chloride was reduced to metallic mercury and volatilized. It was also assumed that the use of the mercury volatilization rate was an appropriate index of activity. This further investigation was made to measure the mercury volatilization rate by flameless atomic absorption. The decrease in mercury concentration by adsorption to sludge and volatilization declined with decreasing sludge concentration. It was found, however, that 20 ppm of sludge was appropriate, and that a sludge concentration below 10 ppm, the amount of volatilized mercury decreased and accuracy of measurement was reduced. Optimum pH and temperature for mercury volatilization were from 8 to 9 and from 42 to 43 C, respectively.

*Mercury, *Waste water treatment, *Activated sludge, Measurement

Volatilization rate, Flameless atomic absorption

D034

CANADIAN CLARIFIER IS LOW IN COST,

Water and Pollution Control, Vol. 114, No. 2, p 27, February, 1976. 1 fig.

An economical and efficient alternative to the conventional clarifier has been designed in Canada. Called the Claripak, the unit has a capital cost of about one half that of a standard clarifier, and considerably reduced maintenance costs, due to the fact that there are no moving parts. The Claripak consists of a series of parallel stainless steel plates lying inches apart and set at a 45 degree angle. Influent, such as a mixture of hydrocarbons, suspended solids and water, is distributed evenly at the top and moves downward over the plate. A laminar flow pattern for improving the settling qualities of the solids is produced. Any hydrocarbon droplets move upwards, contact the upper plate and slide up past a knife-edge into an enclosed discharge channel. Those materials heavier than water move down to a lower plate, and slide into the sludge holding tank. The treated liquid passes through the unit into a collection chamber and flows upward to the outlet connection. The Claripak can be applied both to industrial and municipal facilities. It is suitable for secondary and tertiary treatment at municipal water pollution control plants and for treating back wash wastes from filtration facilities.

*Clarification, *Equipment, *Waste water treatment, *Sewage treatment, *Design, Filtration

*Claripak, Canada

D035

ADVANCED WASTE TREATMENT PLANT FEATURES NITRIFICATION,

Leu, J. E., and Reynolds, M. A.

Camp Dresser and McKee, Incorporated,
Boston, Massachusetts.

Public Works, Vol. 107, No. 4, p 56-61, April, 1976. 3 fig, 2 tab.

New England's first large, single-stage nitrification plant for waste water treatment has been planned for two communities along the Charles River in Massachusetts. It was concluded that a combination of physico-chemical and biological processes would be more efficient than either alone. A single-stage process was selected as simpler and more economical than a two-stage process. The possibility of ultimately serving a larger region was considered in the design criteria. The process steps selected were comminution, primary sedimentation, mechanical aeration, secondary sedimentation, filtration, chlorination, and sludge processing. A filter press will be used to produce a dry sludge cake, which has advantages for landfilling. Onsite disposal as landfill is expected to be feasible until 1998.

*Waste water treatment, *Nitrification, *Treatment facilities, *Design criteria, Biological treatment, Sludge disposal, Landfills

Physico-chemical treatment

D036

MODERN FILTER PRESS TECHNOLOGY FOR SEWAGE SLUDGE DEWATERING,

Gunn, A. S.

Edwards and Jones, Limited,
Meir, Stoke-on-Trent,
Great Britain.

Filtration and Separation, Vol. 13, No. 1, p 72, 74, 76, 78, 80, January/February, 1976. 4 fig, 1 tab.

The Kenosha Water Utility plant in Wisconsin is the first American waste water treatment facility to use British filter presses and sludge dewatering technology. It has been performing at least equal to the design requirements. Sludge build-up was avoided, ensuring a more efficient waste water treatment works. Approximately 3% ferric chloride and 17% lime can be used to dewater raw mixed primary and activated, mixed digested and pre-thickened activated sludge within 2 hours. Average moisture content of the cake was always 60% or less. Full utilization of the plant can increase plant throughput. Success was achieved with in-line conditioning with a buffer tank system, but in-line macerators proved unsuccessful. With this type of automatic plant, periodic checking with C.S.T. or pH meters is useful and reliable in determining the chemical dosage and the conditioned sludge quality. If intensive site testing is performed, chemical filters are selected correctly, and modern equipment is used, it is possible for filter pressing to be effective, economical, and fully competitive with other municipal sludge dewatering methods.

*Dewatering, *Sludge treatment, *Filters, Water treatment, Lime, On-site tests

*Filter presses, Ferric chloride

D037
TREATING SEWAGE AS A RESOURCE REVIVES INTEREST IN LAND DISPOSAL,

Engineering News-Record, Vol. 196, No. 14, p 22-23, April 1, 1976.

Numerous obstacles have been encountered by recently proposed land treatment systems for municipal wastes. Both consulting engineers and the Environmental Protection Agency have contributed to this situation, although the EPA requires that cities consider the method. The advantages of land disposal systems include returning plant nutrients to the land and reuse of water as a resource. Its disadvantages include possible toxic effects of heavy metals in the effluent and the large land areas involved. Land treatment is extremely dependent on land availability and local conditions. Some predict increasing viability for land treatment due to the high costs of other treatment methods. It is believed that land treatment has a particularly good future in small towns, whose smaller operations will cause smaller public acceptability problems. Land treatment is predicted to be popular in suburban regions with the realization that it not only treats sewage but also encourages the growth of crops and provides for open spaces.

*Sewage treatment, *Land treatment, *Water reuse, Crops, Toxicity, Municipal wastes, Waste disposal, Waste water disposal

Land application

D038
THERE IS SOMETHING NEW UNDER THE SUN!,

Wilke, D. A.

Water and Wastes Engineering, Vol. 13, No. 3, p 18-22, March, 1976. 4 fig.

The waste water treatment plant designed for Wilton, Maine, is totally energy conscious; its design uses a fully-integrated architectural/engineering approach, and the plant uses siting to a maximum. The site was chosen to make use of natural terrain for the process hydraulic gravity flow, and the surrounding topography was selected or altered to provide natural weather protection and reflect sunlight onto solar collecting surfaces from snow in winter. The process layout is arranged to eliminate some pumping requirements and conserve heat. The building is well insulated from the outdoors and various areas of the building kept at different temperatures are insulated from each other. The materials were chosen to reduce energy use for heating and lighting and many require little energy in their manufacture. The anaerobic digesters use heat provided by solar energy. Pumps are used only to lift waste water into the plant. Heat from generator coolant, exhaust air, and effluent is recovered with a heat pump. The plant's high degree of self-sufficiency is especially an advantage due to the area's relative winter isolation.

*Waste water treatment, *Treatment facilities, *Energy, Topography, Anaerobic digestion, Design, Heating

*Solar energy

D039

ANAEROBIC DIGESTION OF SOLID WASTE AND SEWAGE SLUDGE INTO METHANE,

Hitte, S. J.

Office of Solid Waste Management Programs,
Environmental Protection Agency,
Washington, D. C.

Compost Science, Vol. 17, No. 1, p 26-36, January/February, 1976. 3 fig, 1 tab, 9 ref.

Anaerobic digestion is discussed as a means of producing methane from organic wastes to offset the natural gas shortage. This process is compared with use of solid waste as a supplemental fuel, pyrolysis, waterwall incineration, and hydrogasification. The current research on anaerobic digestion is summarized. Estimated costs are analyzed for a 1,000-ton-per-day organic waste digestion facility. The only current drawback to implementing such a system is the initial investment. Anaerobic digestion could, if it attains applicable technology stages, maximize conversion of organic wastes into fuel; facilitate materials recovery; handle some industrial wastes and animal and crop wastes mixed with sewage sludge and municipal solid waste; and operate without causing air pollution. The processes will remain separated, however, until the various components, which are already available, are joined into a congruent system for treating both solid waste and sewage sludge.

*Anaerobic digestion, *Sewage sludge, *Solid wastes, Methane, Costs, Industrial wastes, Municipal wastes

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D040

PROCESSES MAKE SEWAGE COME CLEAN MORE CHEAPLY,

Engineering News-Record, Vol. 196, No. 1, p 17, January 1, 1976.

Two variations of conventional sewage treatment techniques have been developed which may enable cities to stretch their funds allocated to water pollution control. Philadelphia, Pennsylvania, is currently testing an activated sludge system which uses an aerator designed to increase air transfer and reduce retention time. The system can reduce capital costs of a full-scale facility by 35 to 40% when compared with conventional aerators, operating costs by 10%, and land requirements by 15%. A 55 gal prototype tested by Philadelphia achieved BOD removals up to 99% on raw sewage containing 200-300 ppm BOD. The system is comparable to a pure oxygen-activated sludge system in performance, power and land requirements but is a simpler system without the disadvantages of the complicated technology of pure oxygen systems. In addition, a plant with conventional aerators is easily converted to one of this type. The second innovative technique is an activated carbon system in which the step needed to reactivate carbon filters after saturation is eliminated. Instead, the system is continually subjected to gamma radiation which induces oxidation of the organics that are held on the carbon. Before the waste water is passed through the carbon filter-irradiator, it is injected with oxygen and ozone. The system has been tested since 1973 at a pilot plant in Marietta, Georgia. Organic concentrations ranging from 100 to 1150 ppm have been consistently reduced by 95%.

*Waste water treatment, *Sewage treatment, *Activated sludge, *Activated carbon, Aeration, Gamma radiation, Pilot plants

D041

THREE-MEDIA FILTRATION PLANT TREATS A PROBLEM WATER,

Flaherty, T. K.

Water Department,
Queensbury, New York.

Public Works, Vol. 107, No. 4, p 67, April, 1976.

Droughts which increased the hardness and iron content of the well water supply of Queensbury, New York, as well as decreasing well output, forced the city to tap the Hudson River as a source of municipal water. Although the river is polluted from municipal and industrial sources with a color content that may exceed 20 units, it is readily amenable to treatment. The main feature of the 3 mgd treatment plant is two automatic backwash filters containing three media types. One of the filters contains a 16 inch bed of granular activated carbon with an 8 x 30 mesh, while the other filter is a dual media filter containing sand and Anthrafilt. Raw water taken from the Hudson is passed through screens which are cleaned by reversing the flow. The inflow is split between two lines which feed identical parallel treatment processes, which can operate separately or simultaneously. In each treatment sequence, the water flows into a rapid mixing basin where alum, caustic soda and chlorine are added for coagulation, pH adjustment, and disinfection, respectively. Water then flows through flocculation basins where activated carbon, potassium permanganate and a polymer may be added. The water is then retained for three hours in rectangular electrifiers. Clarified water is fed to the dual media filter and then to the carbon bed filter. Backwashing is initiated by loss of head, automatically, or at specified time intervals. The filtered water is chlorinated, neutralized, and stored before being released to the distribution system.

*Water treatment, *Water works, *Treatment facilities, *Color, Water supply, Rivers, Wells, Filtration, Activated carbon, Potable water

Dual media filters, Activated carbon filters

D042

KINETICS AND CONTROL TESTS OF NITRIFICATION-DENITRICATION PROCESS, PART I: KINETICS,

Wang, L. K., Wang, M. H., Poon, C. P. C., and Bergenthal, J.

Rensselaer Polytechnic Institute,
Troy, New York.

In: Proceedings of the 22nd Annual Technical Meeting of the Institute of Environmental Sciences, April 26-28, 1976, Philadelphia, Pennsylvania, p 496-500. 18 ref.

Organic nitrogen, ammonia nitrogen, nitrite nitrogen and nitrate nitrogen add to total oxygen demand by contributing a nitrogeneous oxygen demand (NOD). Since 1970, it has been recognized that this nitrogeneous oxygen demand is a potential load of stream pollution as well as the carbonaceous BOD. Activated sludge systems are now being designed that incorporate nitrification and denitrification into the overall treatment. General kinetic equations for nitrification and denitrification are presented. Important process design criteria are reviewed and discussed. Various activated sludge configurations include a three-stage biological system, a single stage unit in which sufficient time is allowed for the development of the nitrifying organisms, or a plug-flow aerobic-anoxic aeration unit. The equations presented can be considered to be mathematical models of nitrification-denitrification kinetics and chemistry.

*Waste water treatment, *Activated sludge, *Nitrification, *Denitrification, Kinetics, Mathematical models, Biochemistry, Nitrogen compounds

Nitrogeneous oxygen demand

D043

KINETICS AND CONTROL TESTS OF NITRIFICATION-DENITRIFICATION PROCESS, PART II: RESPIRATION AND CONTROL TESTS,

Beer, C., Wang, L. K., and Bergenthal, J.

New York State Department of Environmental Conservation,
Albany.

In: Proceedings of the 22nd Annual Technical Meeting of the Institute of Environmental Sciences, April 26-28, 1976, Philadelphia, Pennsylvania, p 501-508. 12 ref.

The kinetics and chemistry relating to oxygen respiration, substrate nitrate respiration, endogenous oxygen respiration, and endogenous nitrate respiration are discussed. Equations are presented for the following reactions: biological oxidation in the carbon oxidation unit; oxygen respiration in the carbon oxidation unit for glucose and for sewage; biological oxidation in the nitrification unit; oxygen respiration in the nitrification unit for sewage; the overall energy reaction in denitrification; substrate nitrate respiration for glucose and for sewage; endogenous oxygen respiration; and, endogenous nitrate respiration. The bacterial mass of a single-stage activated sludge system which incorporates carbonaceous BOD removal and nitrification-denitrification consists of three types of organisms: facultative anaerobes which perform nitrate respiration; aerobic bacteria which cannot perform nitrate respiration, and nitrifiers, nitrosomas and nitrobacter, which are capable of oxidizing ammoniacal compounds into nitrates. For plant control purposes, it is useful to obtain an estimate of the mass of nitrifying organisms and of the mass of facultative anaerobes present in the activated sludge, and to obtain a measure of their performance under uninhibited standardized conditions. The methodology for tests of nitrifying ability, denitrifying ability, and oxygen uptake rate are presented.

*Waste water treatment, *Activated sludge, *Nitrification, *Denitrification, Mathematical models, Kinetics, Respiration, Oxygen uptake rate, Analytical techniques, Control schemes

Nitrifying ability, Denitrifying ability

D044

COMBINATION OF PHYSICAL CHEMICAL PROCESSES OF WASTE WATER PURIFICATION WITH OZONE TREATMENT (KOMBINATION PHYSIKALISCH-CHEMISCHER VERFAHREN DER ABWASSERREININGUNG MIT OZONBEHANDLUNG),

Dietrich, K. R.

Chemiker-Zeitung, Vol. 100, No. 2, p 68-71, 1976. 1 fig, 2 tab, 3 ref.

A method has been developed for the decomposition of organic wastes. The process involves the steps of physico-chemical treatment, precipitation, flocculation, adsorption, and flotation, together with an ozonization step. The precipitation/flocculation/adsorption/flotation step removes at least half of the organic compounds from the waste water; the remainder is decomposed by ozone in a second step. Color and odor are removed and stringent BOD and COD requirements will be met. The system has been applied to the treatment of both industrial and municipal waste water.

*Organic compounds, *Waste water treatment, *Ozone, Municipal wastes, Industrial wastes, Chemical precipitation, Flocculation, Adsorption, Biochemical oxygen demand, Chemical oxygen demand

D045

HOW TO DESIGN AERATED LAGOON SYSTEMS TO MEET 1977 EFFLUENT STANDARDS EXPERIMENTAL STUDIES,

White, S. C., and Rich, L. G.

Water and Sewage Works, Vol. 123, No. 3, p 85-87, March, 1976. 8 fig, 1 tab.

Experimental studies on controlling suspended solids in effluents of aerated lagoon systems are being carried out in South Carolina in two phases. One phase is a field study of the characteristics of the solids in the influents and effluents of polishing ponds of several existing aerated lagoon systems. In this phase, samples were taken of the effluents and influents of six lagoon systems on five different days in a dry weather period in late summer. During the period studied, effluents did not consistently meet the standard for suspended solids, 30 mg/liter. Some polishing ponds actually increased the concentration of suspended solids. A correlation exists between algae growth in aeration cells and power level. The non-algal portions of the suspended solids in the effluents apparently meet the standard of 30 mg/liter. A laboratory study was performed to determine how biological solids' settling characteristics change with the mean solids retention time. In this experiment, a given volume of synthetic waste water was added daily to an aerated cone to replace an equal volume of the contents, which was wasted. The settling characteristics of biological solids for a given waste water are affected by both the mean solids retention time and suspended solids concentration. At 22 and 23 C, mean solids retention times of 4 and 5 days produced optimal settling characteristics for relatively high suspended solids concentrations. Times of about six days produced optimal settling for more dilute concentrations.

*Aerated lagoons, *Waste water treatment, *Suspended solids, Aerobic treatment, Sedimentation

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D046

DESTRUCTIVE AIR DEODORISATION AT A DUBLIN SEWAGE WORKS,

Summer, W.

Process Biochemistry, Vol. 11, No. 1, p 26-27, January/February, 1976.

Sewage odors emanating from the end point of waste collection pipeline at the Sewage Pumping Station, Dublin had caused an environmental problem. Such sewage air contains indole or benzopyrrole (C_8H_7N), skatole or methylindole (C_9H_9N) and hydrogen sulfide. Ozone had been generated at the Pumping Station by means of a silent electric discharge in a chamber through which air was passed. This method proved ineffective, and a new system was designed in which the foul air is passed through a radiation field of defined wavelengths and intensity, so that nascent oxygen atoms will form and attach themselves to the organic molecules, thus oxidizing them. Surplus oxygen will form ozone, indicating that the deodorization is complete. The radiation field is produced by ultra-violet generators of the monokymatic mercury discharge type. The advantage of producing nascent oxygen atoms is that there is a gap in the absorption spectrum of nitrogen where the emission of ultraviolet energy is a maximum; thus no nitrous gas contaminants will be formed by the breakdown of nitrogen molecules into atoms. Using five reaction chambers in series, this method has been employed to treat a sewage air flow of up to 5000 cu m per hour.

*Odor, *Sewage treatment, *Hydrogen sulfide, Ozone, Oxygen, Ultraviolet radiation

D047

REVIEW OF ADVANCED TREATMENT TECHNIQUES FOR WASTE WATER,

Bayley, R. W., and Cooper, P. F.

Berichte der Abwassertechnischen Vereinigung e.V., No. 28, p 245-258, 1976. 5 fig, 6 tab, 16 ref.

Conventional methods of waste water treatment, while successful in some respects, remove little nitrogen and phosphorus from the wastes and are poorly adapted to sudden changes in waste water. Alternative treatment methods are being studied to remedy these problems. The activated sludge process has been modified to remove significant amounts of oxidized nitrogen from final treated effluent. Some existing plants would be able to use this method. The modified process would require additional mixed-liquor tank capacity to accomodate anoxic reactors, but its costs would probably be outweighed by the resulting savings in aeration equipment costs. High quality water may be obtained using commercially available reverse osmosis equipment. Application of the process is seriously restricted, however, by the costs involved in maintaining the high operating pressure required. This situation could be changed markedly by the development of new membranes operating at lower pressures. Several chemical methods of primary treatment have been examined, but problems have been encountered. Adsorption onto activated carbon does not efficiently remove all of the soluble organic matter present in sewage. Urea also persists in sewage, and limiting the nitrogen in the final effluent may require biological processes.

*Waste water treatment, *Tertiary treatment, *Nutrient removal, Phosphorus, Nitrogen, Activated sludge, Anaerobic conditions

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D048

PRESTON SEWAGE LIFT STATION MEETS FLUCTUATION IN FLOW,

Water and Pollution Control, Vol. 114, No. 3, p 20-21, March, 1976. 2 fig.

A new sewage lift station is to be constructed in the Preston, Ontario, area. The residential area plans further development, and flow during the next ten years may vary from one million gpd to 20 million gpd. To provide for the large fluctuation, engineers had to consider pipeline diameters and estimate pump duties. Selected Napier-Reid pumps should meet possible changes from low to high flows in relatively equal stages. When the sewage lift station is in operation, flows will be screened before entering the sump; screenings will be removed by a dumbwaiter to the disposal exit. Air abstracted from the station is to be treated with ozone before discharge. A fresh air inlet is provided, in the direction of the base of the wet well, for the benefit of maintenance operators.

*Sewage treatment, *Pumps, *Pipes, *Pipe flow, Pipelines, Waste water treatment, Ozone

Sewage lift station, Ontario (Canada)

D049
WASTEWATER PLANT WILL USE NO CHEMICALS FOR SLUDGE CONDITIONING,

Josti, J.

Camp Dresser and McKee Incorporated,
Boston, Massachusetts.

Water and Sewage Works, Vol. 123, No. 3, p 66-69, March, 1976. 4 fig.

The new East Shore waste water treatment plant in New Haven, Connecticut, will not use chemicals to condition sludge and will produce the sodium hypochlorite it uses for disinfection. The facility was designed for 40 mgd daily average flow and 100 mgd peak hourly flow. The equipment for treating the waste water will include a wet well, five vertical centrifugal pumps, four comminutors, primary sedimentation tanks where sludge, grit, and scum will be removed, aeration basins, final sedimentation basins, and two chlorine contact basins. The grit will be incinerated, and the scum and the primary sludge will be mixed. Normally, equal amounts of primary thickened sludge and waste activated sludge will be blended with some scum in a blend tank. After oxidation, the dewatered blended sludge will be incinerated. An economic analysis showed that producing sodium hypochlorite on site was the least expensive type of disinfection system. The sodium hypochlorite will be produced by electrolysis of screened, warm seawater used for cooling at a nearby electric generating station. Laboratory areas, personnel areas, and plant controls, as well as various process units, will be housed in the process building. An illuminated panel indicating the status of various units, a logging typewriter, a cathode ray tube alarm, and various controls will enable the operator to observe and control the process.

*Waste water treatment, *Treatment facilities, *Sludge treatment, *Disinfection, Sodium compounds, Activated sludge

Waste activated sludge, Sodium hypochlorite

D050
CHEMICAL FEED: IT'S A WAY OF LIFE AT WINDSOR,

Water and Pollution Control, Vol. 114, No. 3, p 6-7, March, 1976.

The city of Windsor, Ontario, is attempting to economize the costs of Ontario's program for nutrient removal in its sewage treatment plants. Much work has been directed toward ensuring that chemicals are added proportionately to flow. Three of the city's projects use dry chemical feed; two use liquid chemicals. Dry polyelectrolytes are wetted before use. The particles are then mixed in solution and transferred to a feed tank. A meter controls application of the polymer solution from this tank. Switching to chemical treatment increased the quantity of sludge and changed its composition. Various polymers are being evaluated to correct the problem. The city also uses ferric chloride and lime for dewatering. Another project adds a phosphorus removal chemical directly to raw sewage, reducing biochemical oxygen demand loading and increasing sludge volume. This sludge is dewatered by centrifugation. Polymer effectiveness varies between the city's two sewage plants, depending upon the characteristics of the raw sewage.

*Nutrient removal, *Sewage treatment, *Chemical precipitation, *Polymers, Dewatering, Sludge treatment, Polyelectrolytes, Phosphorus

Ontario (Canada)

D051

ALUM SLUDGE FROM WATER PLANT CONDITIONS SEWAGE SLUDGE,

Hsu, D. Y.

Wayne State University,
Detroit, Michigan,
Department of Civil Engineering.

Water and Sewage Works, Vol. 123, No. 3, p 62-64, March, 1976. 3 fig, 12 ref.

Water treatment plants supplying potable water produce their own waste water in the form of sludge from sedimentation tanks. Use of small doses of polyelectrolytes instead of alum reduces the amount of sludge. The sludge produced is also easier to dewater and incinerate. Because of the higher cost of the polymers, a combination of alum and polymers may be used. The simplest method of on-site treatment of alum sludge is sludge lagooning. The same function, that of thickening the sludge, can also be performed by gravity thickeners. The most important subsequent procedure for treating the sludge is dewatering. Usually, the sludge is conditioned either physically or chemically and then dewatered mechanically. Treating sludge from water treatment together with waste water sludge is the most promising method for treating alum sludge off-site. When properly thickened and mixed with waste water sludge, alum sludge can be used to condition it for dewatering.

*Water treatment, *Waste water, *Sludge treatment, Potable water, Polyelectrolytes, Dewatering, Polymers, Lagoons

Alum

D052

NUTRIENT MASS BALANCE IN COLUMNS REPRESENTING FILL SYSTEMS FOR DISPOSAL OF SEPTIC TANK EFFLUENTS,

Magdoff, F. R., and Keeney, D. R.

Vermont University, Burlington,
Department of Plant and Soil Science.

Environmental Letters, Vol. 10, No. 4, p 285-294, 1975. 3 fig, 3 tab, 11 ref.

The distribution of carbon, nitrogen, and phosphorus was investigated in a simulated fill system for disposal of septic tank effluent. The fill system's vertical dimensions were represented in soil columns, which were dosed with septic tank effluent. After prolonged leaching, analysis revealed that carbon and nitrogen accumulated mainly in and just below the crust on top of the 60 cm sand layer. Carbon and nitrogen were sufficiently depleted from the 30 cm layer and silt loam just above the lowest layer to produce a net carbon and nitrogen loss from the soil The columns removed approximately 22% of the influent nitrogen and almost all of the chemical oxygen demand. Influent carbon was removed by microbial respiration. Adsorption, precipitation, or a combination of the two removed phosphorus from the liquid phase; the phosphorus lost was recovered by analysis of the column soil materials.

*Nutrient removal, *Waste water disposal, *Septic tanks, Nitrogen, Phosphorus, Carbon

D053

REVERSE OSMOSIS SEPARATION OF POLAR ORGANIC COMPOUNDS IN AQUEOUS SOLUTION,

Fang, H. H. P., and Chian, E. S. K.

Illinois University,
Urbana,
Civil Engineering Department.

Environmental Science and Technology, Vol. 10, No. 4, p 364-369, April, 1976.
8 fig, 4 tab, 19 ref.

Reverse osmosis was studied as a means to separate polar organic compounds from water. Thirteen polar organic compounds with low molecular weight, consisting of various functional groups, were used to test 12 reverse osmosis membranes. These compounds were separated less effectively than inorganic salts by all membranes tested. The aromatic-polyamide-(AP)-, NS-type, and cellulose acetate base membranes gave overall polar organic compound separations of 50%, 75%, and between 13% and 27%, respectively. The chemical nature and characteristics of both the molecule and the membrane determine the separation of a particular organic compound by a given membrane. Compounds with any given functional group are separated increasingly as the molecule size and branching increase. The overall separations obtained experimentally can be considered as minimum values when applying reverse osmosis in waste water treatment.

*Reverse osmosis, *Waste water treatment, *Organic pollutants, Membrane processes, Membranes, Separation techniques

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D054

WATER SUPPLY AND SEWAGE TREATMENT IN ARID AREAS,

Water Services, Vol. 80, No. 960, p 79-80, February, 1976.

Sewage treatment and water supply pose special problems in areas like the Middle East, in which potable water is scarce due to special environmental and geographical factors. The characteristics of the water and sewage may also be different from those found in other areas. Possible water sources include: springs, deep boreholes, and protected catchments; treated water from unprotected catchments, rivers, lakes, and water holes; and desalination of water from oceans and saline wells. Possible methods of sewage treatment include oxidation ponds, percolating filters, tertiary treatment lagoons, and sand filters. Preliminary polluted water treatment in remote areas should be simple, avoiding open storage tanks and reservoirs, with suitably treated water being used to reclaim desert land for agriculture. A need for practical guidance exists in the remote areas, due to unfamiliarity with proper treatment facilities. Although there are many plans for treatment of water and sewage in parts of the Middle East, good water supplies are virtually unknown in many areas.

*Waste water treatment, *Water supply, *Water sources, *Sewage treatment, Desalination, Oxidation lagoons, Filtration, Potable water

D055
THE USE OF OXYGEN IN THE TREATMENT OF WASTE WATER,

Notes on Water Research, No. 1, p 1-4, December, 1975. 28 ref.

Sufficient dissolved oxygen is essential for aerobic biological treatment of waste water. Using oxygen rather than air increases the rate at which oxygen is dissolved almost fivefold. Oxygen is produced commercially by fractional distillation of liquified air. Oxygen-enriched air is produced by pressure-swing adsorption (PSA), in which nitrogen is adsorbed from air using a zeolite. The relative costs and power requirements of PSA and the cryogenic process depend on the plant size. The techniques for more efficient oxygen use in the activated-sludge process include: agitation of oxygen and mixed liquor in a covered tank for several hrs prior to separating the effluent and sludge in a conventional sedimentation tank; releasing oxygen at the bottom of the tank; temporarily separating a side-stream of liquor into which oxygen is injected under pressure; and injecting the oxygen into a mixed liquor stream flowing downward. The advantages claimed for treating waste water with oxygen include dissolving oxygen in the mixed liquor rapidly enough that dissolved oxygen does not limit the biochemical oxidation rate; possible reduction of aerial nuisance with covered tanks; better settling characteristics and smaller quantities of sludge; and reduction of the possibility of sludge bulking. The disadvantages of oxygen use include reliance on either complex equipment or an external manufacturer, greater energy use to produce and dissolve oxygen, the need to modify the process to achieve nitrification in single-stage plants, and possible hazards in using and storing oxygen.

*Oxygen, *Activated sludge, *Aerobic treatment, *Dissolved oxygen, *Waste water treatment

Oxygen activated sludge

D056
SEWERAGE PROJECT ON UPSTREAM AREA OF THE YAMATO RIVER,

Yamada, M.

Civil Engineering in Japan, Vol. 14, p 122-132, 1975. 4 fig, 2 tab.

The Yamato River's upstream area is in a mountainous area of Nara Prefecture, one of Japan's historic and scenic areas. A regional sewerage project administered by the prefectural government was begun in 1970 to alleviate a pollution problem which had become apparent in the river. A treatment center was built in a low area surrounded by mountains, so that a natural flow system can be used. Treatment is based on the activated sludge process. Circular radial-flow type primary settling tanks are used. The aeration tank can be used for step aeration or tapered aeration as the load changes. Only the final settling tank is not enclosed. As much as possible of the operation is automated. Only about half of the treatment center site is used for present needs. The remainder is used as a recreation area.

*Waste water treatment, *Activated sludge, *Treatment facilities, Sewerage, Water pollution control, Settling basins, Aeration

D057
REVERSE OSMOSIS TODAY,

Process Biochemistry, Vol. 11, No. 1, p 32-34, January-February, 1976. 3 fig, 2 tab.

Representatives of various industries participated in a 2 day seminar on principles, applications, and limitations of reverse osmosis. Techniques and membrane configurations discussed include the plate and frame technique, the spiral wound technique, the tubular technique, the spaghetti technique, and the hollow fiber technique. For all of these techniques, water should not exceed stipulated pH, temperature, and chlorine levels or contain excessive hardness, particulate matter, dissolved iron, or colloidal matter. The membranes reject organic molecules with high molecular weights, including nearly all viruses and pyrogens. Reverse osmosis reduces salt by approximately 90 to 95% independently of total dissolved solids levels under approximately 1500 ppm for most waters. Because reverse osmosis is compact, it is sufficiently mobile for treating drinking water in emergencies. Use of reverse osmosis in waste water treatment is expected to increase; it can provide for recycling of effluents when combined with filtration and ion exchange. It is expected that reverse osmosis will also be used for desalination of sea water. Reverse osmosis has been used for 18 mo virtually without problems to purify water for a soft drink manufacturing plant. Another factory obtained sufficiently pure water with reverse osmosis for use in manufacturing tablets. Reverse osmosis systems must be matched to local conditions such as turbidity, water hardness, and colloid levels.

*Reverse osmosis, *Water treatment, *Waste water treatment, Desalination, Membrane processes, Water reuse

Membrane configurations

D058
PACKAGE SEWAGE TREATMENT PROCESS,

Martin, M. J.

Process Biochemistry, Vol. 11, No. 1, p 29-30, January-February, 1976. 1 fig, 1 ref.

The Degremont Diapac U.I. sewage treatment system is designed to serve populations of 100 to 30,000 inhabitants. Operation is automated as much as possible. The plant contains two compartments for aeration, clarification, or both as well as equipment for pumping and screening raw sewage. It may be extended to meet future requirements. The treatment system, which operates as an extended aeration activated sludge process, makes use of the fact that activated sludge from such a process can undergo relatively long periods with no aeration. It uses the same unit for nitrification and denitrification. The two compartments alternate between aeration and solids/liquids separation. A timer mechanism controls the change of functions.

*Waste water treatment, *Treatment facilities, *Sewage treatment, Aeration, Activated sludge, Denitrification, Nitrification, Anaerobic conditions

*Package plants

D059

REMOVAL OF FAECAL COLIFORM FROM WASTE WATER BY PROPER AEROBIC BIOLOGICAL TREATMENT,

Howe, R. H. L.,

Notre Dame University,
Notre Dame, Indiana.

Process Biochemistry, Vol. 11, No. 1, p 18-19, 24, January-February, 1976. 1 tab, 16 ref.

Public health protection is the most important reason for waste water treatment. An initial principal objective of aerobic biological waste water treatment is the removal or reduction of bacteria. Biological flocculation, which brings bacteria together into a biological mass as a part of aerobic biological treatment, makes it possible to separate them mechanically. Undesirable anaerobic bacteria cannot survive in the aerobic environment provided by aerobic biological oxidation. Some microorganisms interfere with certain other bacteria's survival. The effluents from trickling filter, activated sludge, or anaerobic digestion contain smaller numbers of all microorganisms present in the sewage before treatment. These microorganisms will be more concentrated in the accumulated solids than in the liquid portion. Removal of microbes parallels biochemical oxygen demand and chemical oxygen demand, and microbial density, especially that of coliform, is likely to be at a minimum when they are at a minimum. Coliforms can occur in waste water that does not contain sanitary sewage.

*Waste water treatment, *Aerobic treatment, *Coliforms, Biological treatment, Public health, Biochemical oxygen demand, Chemical oxygen demand

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D060

MICROBIOLOGY AND ACTIVATED SLUDGE,

Jones, G. L.

Process Biochemistry, Vol. 11, No. 1, p 3-5, 24, January-February, 1976. 3 fig, 1 tab, 6 ref.

Waste water is treated biologically by bringing it into contact with suitable microorganisms for a sufficient period of time for the microorganisms to metabolize the polluting constituents to the required extent. Maintaining a high bacterial mass concentration in the aeration tank and a low substrate concentration in the effluent produce cultural conditions resembling those near the end of a batch culture with nearly exhausted substrate, minimal bacterial growth rate, and possibly decreased viability of the culture. The bacterial population in activated sludge is predominantly moribund, but biochemical oxygen demand (BOD) in sewage can be removed without viable bacteria. Protozoa are also present in activated sludge systems, their role being primarily concerned with clarifying the final effluent. The rate of sludge removal from the system is very important in controlling activated sludge. The obtainable degree of treatment and the quantity of biological solids produced from the BOD applied to the system depend on it. The most common, and probably most successful, kinetic models of activated sludge, have been pragmatic models describing the overall plant performance in terms of a non-specific parameter such as BOD on first-order kinetics. Most microbiological models do not account for the relatively low proportion of viable bacteria in activated sludge. Settlement and recycling are used to increase the concentration of biomass in contact with the waste water. This serves two purposes: increasing the rate of waste water purification; and, reducing the amount of biological solids produced from the BOD removed.

*Activated sludge, *Microorganisms, *Kinetics, *Waste water treatment, Microbiology, Bacteria, Protozoa, Biomass

D061

EVALUATING ROTATING BIOLOGICAL CONTACTOR PERFORMANCE,

Stover, E. L. and Kincannon, D. F.

Roy F. Weston, Incorporated,
West Chester, Pennsylvania.

Water and Sewage Works, Vol. 123, No. 3, p 88-91, March, 1976. 8 fig, 1 tab, 4 ref.

The relationship of the organic concentrations and flow rates of a synthetic carbohydrate waste water and an industrial waste water and their influence on the removal of organics in a rotating biological contactor were investigated. A 4 ft long pilot system with 10 gal capacity was used in the investigations. Microbial populations were started in the waste water with an initial seed of sewage from a sewage treatment plant. Waste water was pumped into the first treatment stage, from which it flowed through the following five stages. Samples were collected at the influent line and at the end of every stage, and their pH, dissolved oxygen, influent and effluent temperatures, and chemical oxygen demand were measured. Increases in organic concentration and flow rate caused decreases in removal rates and treatment efficiencies. First-order decreasing removal rates at each stage are characteristic of the process for both types of waste water. The rotating biological contactor's response to treatment of various waste waters varies with the constituents and characteristics of the waste waters. The removal efficiencies approach constant minimum values as the organic loadings increase.

*Waste water treatment, *Biological treatment, *Organic loading, *Flow rate, Chemical oxygen demand, Dissolved oxygen, Efficiencies

Rotating disc

D062

THE EFFECT OF FLOCCULANTS ON POSTCOAGULATION SLUDGE DEWATERING (Wplyw flokulantow na odwadnialnosc osadow pokoagulacyjnych),

Grossman, A., Koscielniak, H., Kusznik, W., and
Pawlita, W.

Inzynieria Sanitarna, Vol. 19, No. 443, p 103-117, 1976. 3 fig, 2 tab, 9 ref.

The effects of flocculants on the resulting sludge and its dewaterability characteristics following coagulation were investigated. Studies were performed on commercial and laboratory scales to determine an adaptation of a method of filtration resistance measurement commonly used to estimate sludge characteristics, as well as to determine the effect of different combinations of reacting substances used in coagulation on the degree of sludge dewatering. It was found that the known method of measurement of waste water sludge filtration resistance is applicable to testing post-coagulation sludge dewatering. Thy proper selection of a filter size had a significant effect on the filtration resistance measurement and filter cloth BT-103 was useful for this measurement. In addition, application of flocculating agents in combination with the coagulant lowers the coefficient of the post-coagulation sludge filtration resistance.

*Flocculation, *Sludge treatment, *Dewatering, *Filtration, Measurement, Waste water treatment

D063

EFFECTS OF ACTIVATED CARBON ADDITION TO THE ACTIVATED SLUDGE PROCESS (Wplyw dodatku wegla aktywnego do procesu osadu czynnego),

Suschka, J., and Pusz, I.

Inzynieria Sanitarna, Vol. 19, No. 443, p 19-32, 1976. 12 fig, 4 ref.

Laboratory scale experiments were performed to study the effect of the direct addition of activated carbon to the aeration tank in the activated sludge process. A definite increase in the removal of biochemical oxygen demand (BOD) was noted. However, no significant changes in the effectiveness of COD removal with the added activated carbon could be observed. Also, the nitrification process was slowed in the experimental activated carbon unit.

*Activated carbon, *Activated sludge, *Aeration, *Waste water treatment, Laboratory tests, Biochemical oxygen demand, Chemical oxygen demand, Nitrification

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D064

NEWMARKET'S REPLACEMENT SEWAGE TREATMENT WORKS,

Water Services, Vol. 80, No. 959, p 50-51, January, 1976.

A new sewage treatment works recently replaced the town of Newmarket's original works in Great Britain. The works will serve a population of 20,000 initially, and can be expanded to serve 30,000. One tenth mgd of the design dry weather flow of 1.1 mgd represents flows from the village of Exning. The primary settlement and storm water tanks are located at an intermediate level between the aeration tanks and the incoming sewer, resulting in two pumping stages with screw pumps. All sludge is transported nine miles to Cambridge's works for final treatment. Newmarket's main flows pass through a measuring flume incorporating emergency overflow channel. After they are pumped to the first level and joined by sewage from Exning, grit is removed in aerated grit channels. The channel conveying the sewage to the sedimentation tanks has an overflow channel in case the second stage pumping should fail. The primary sedimentation tanks have continuously revolving scrapers sweeping sludge into a sump from which it is discharged. The flows are then pumped to two adjoining aeration chambers. The effluent is gravity fed from the aeration chambers to two settlement tanks providing the last stage of treatment. Activated sludge from these tanks is recirculated. Combined secondary and primary sludge discharged from the primary tanks flows by gravity to sludge storage/thickener tanks which hold it until delivery to Cambridge. These tanks have fixed bridge stirrers, helping to release supernatant water.

*Waste water treatment, *Treatment facilities, *Sewage treatment, Storm water, Flow rates

Great Britain

D065

COMBINED UTILITY PROVIDES WATER AND WASTEWATER TREATMENT,

Water and Sewage Works, Vol. 123, No. 2, p 70, February, 1976.

A new facility near Boynton Beach, Florida, will soon begin treating both water and waste water. It is designed to serve 4,740 units in two developments. Water is pumped from two wells, and must be treated to remove iron and hydrogen sulfide. The water is aerated and lime, alum, and certain polyelectrolytes are added. Mechanical scrapers collect the precipitate which is produced. The system collects the effluent through radial launderers and passes it through a medium of polishing sand, graded gravel, and anthrafilt. Two pumps distribute the water among the four cells containing the medium. A contact stabilization unit having extended aeration capabilities is used to treat the waste water. The waste water being treated will be almost entirely domestic. After the effluent is treated and chlorinated, it is conducted to two oxidation ponds. From there it will enter two transpiration-evaporation ponds. Construction costs total approximately $2.1 million, not including engineering land land. Palm Beach country will take over the utility when it is completed.

*Waste water treatment, *Water treatment, *Treatment facilities, Hydrogen sulfide, Iron, Chemical precipitation, Chlorination, Construction costs

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D066

REGINA TERTIARY TREATMENT PLANT STUDY AND DESIGN,

Stewart, M. J., and Lewis, D. H.

Water and Pollution Control, Vol. 114, No. 3, p 28-32, 34-35, March, 1976. 3 fig, 2 tab.

A 1972 study showed that the waste water treatment works for the city of Regina, Canada, contributed substantial amounts of nitrogen and phosphate to local rivers. The capacity of these treatment works had been increased in 1970 by adding two series-flow aerated cells. A research program on tertiary treatment was undertaken to evaluate chemically treating stabilization pond effluent used with a settling-tube module, high-rate, upflow clarifier. There was a need for developing an economical means to improve the effluent from stabilization ponds. A pilot plant was constructed in 1971. Its main features include flow control, rapid mix, chemical feed, flocculation, and high-rate clarification facilities. It received effluent from the City's outfall line before chlorination and returned waste sludges and treated flows to the outfall. Various dosages of alum and lime were tested between September and December 1971. Further tests at warmer temperatures were performed between May and July 1972. Higher flow rates, removal of the settling-tube module, and two sampling methods were studied. Samples were tested onsite for pH, color, temperature, alkalinity, turbidity, and hardness and for other characteristics at the University of Saskatchewan. The approximate weight of algae in samples from the stabilization pond could be determined by multiplying the measured concentrations of chlorophyll by 0.05.

*Tertiary treatment, *Waste water treatment, Nitrate, Phosphate, Rivers, Waste disposal, Chemical precipitation, Treatment facilities, Nutrient removal, Pilot plants

D067

THE PERFORMANCE-POTENTIAL OF POLYELECTROLYTES AND HIGH VELOCITY GRADIENTS IN THE TREATMENT OF WASTEWATERS,

Ogedengbe, O.

Ife University,
Ile-Ife, Nigeria,
Department of Agricultural Engineering.

Water Research, Vol. 10, No. 4, p 343-349, 1976. 5 fig, 6 tab, 11 ref.

The use of cationic polyelectrolytes for treating domestic sewage was studied at various velocity gradients and periods of rapid mixing, both with and without coagulant-aids. Slow mixing and settling followed the rapid mixing. Velocity gradients as high as 500/sec may be desirable for waste water treated with cationic polyelectrolytes. Rapid mixing periods as long as about 25 min also may be desirable. Use of bentonite clay as a coagulant aid improved the turbidity removal, but aluminum sulfate and sodium aluminate were even more effective. Sedimentation in sewage samples which had been treated with polyelectrolytes was essentially completed in 10 to 15 min. Overall performance of somewhat overloaded waste water treatment plants might be improved by using high velocity gradients, polyelectrolytes, and coagulant aids.

*Polyelectrolytes, *Waste water treatment, *Sewage treatment, Coagulation, Performance, Cations, Turbidity

Alum, Sodium aluminate

D068

AMMONIA REMOVAL BY USE OF CLINOPTILOLITE,

Jorgensen, S. E., Libor, O., Graber, K. L., and Barkacs, K.

Langkaer Vaenge,
Copenhagen, Denmark.

Water Research, Vol. 10, No. 3, p 213-224, 1976. 12 fig, 7 tab, 12 ref.

The ion exchange process, using the ammonium selective ion exchanger clinoptilolite, was studied, including the dependence of the efficiency and capacity on pH, flow, and interval of regenerations and practical use in a combined physical-chemical method with chemical precipitation. The basic process was investigated in ammonium chloride, hydrochloric acid, and ammonia solutions, and in ion-free distilled water. Ammonia removal was studied as a function of time, volume treated, and number of regenerations. An attempt was made to reproduce the results of these laboratory experiments in pilot plant tests. Clinoptilolite works by ion exchange at low concentrations of the counter ion; adsorption increases at higher concentrations. The capacity is apparently around 8 mmol/100 g. The electrochemical properties of the counter ion are similar to those of the ammonium ion. The efficiency increases with the amount of material used up to a certain level. Increasing the contact time increases the capacity for times up to 120 min. Increasing the number of regenerations increases the capacity up to three regenerations. The other ions present in waste water and tap water considerably reduce the ammonium-removal capacity as compared to distilled water. Five to 10/vv is a preferred flow rate. A combined method with chemical precipitation gives 90% removal efficiency of both organics and ammonium. The results can be duplicated on a pilot plant treating 100 liters/hr.

*Ion exchange, *Polyelectrolytes, *Ammonium, Chemical precipitation, Pilot plants, Adsorption, Organic compounds

*Clinoptilolite, Ammonia removal, Physico-chemical treatment

D069

CONDITIONING IMPROVES SLUDGE FILTERABILITY,

El-Gohary, F. A., and Saleh, M.

Water Pollution Control National Research Center,
Cairo, Egypt.

Water and Sewage Works, Vol. 123, No. 3, p 72-76, March, 1976. 6 fig, 9 tab, 19 ref.

Secondary sludge, consisting almost entirely of microorganisms produced during biological treatment, is usually harder to concentrate than primary sludge. Because it is economically difficult to provide the space required for sludge drying, the sludge must be treated with filtering agents and mechanical methods to accelerate drainage. The properties of excess sludge from a contact stabilization pilot plant were studied. The ability of surplus activated sludge to be dewatered by vacuum filtration was investigated with laboratory scale procedures. Ferric chloride, ferrous sulfate, calcium oxide, and Nalco '600 S' were used as coagulants. Sludge was thickened, reducing the volume by about 20%, before chemical treatment or aerobic digestion. The sludge's specific resistance tended to increase at increasing pressures. The specific resistance of surplus sludge from the stabilization zone was 2.09 times 10 to the 10th power after 18 hr aeration, 3.19 times 10 to the 10th power after 42 hr aeration, and 2.5 times 10 to the tenth power after 90 hr of aeration. When nitrogne and phosphorus salts were added to the sludge prior to aeration, increasing the aeration time improved the rate of filtration. Ferric chloride was the best coagulant for treating surplus activated sludge under the conditions studied. Coupling 100 mg/liter ferrous sulfate with 100 mg/liter calcium oxide also improved the clarification rate of the supernatant. Nalco '600' in dosages between 5 and 10 mg/liter reduced the sludge volume between 21 and 23%.

*Sludge treatment, *Filtration, *Activated sludge, Dewatering, Coagulation, Waste water treatment

Sludge conditioning, Ferric chloride

D070

TWO-STEP PHOSPHATE REMOVAL FROM SOLUTION USING ALUMINUM SALTS,

Hsu, P. H.

Rutgers University,
New Brunswick, New Jersey,
Department of Soils and Crops.

Environmental Letters, Vol. 10, No. 4, p 311-317, 1975. 2 tab, 4 ref.

It is possible to precipitate phosphate from waste water using iron, aluminum, or lime, but this is seldom done. The procedure has been considered too expensive, although there is little conclusive information on costs. Both low residual phosphate concentration and large amounts of phosphate precipitated per mole of coagulant are desired, but these two criteria are not always compatible. An experiment was performed in which phosphate was precipitated from phosphate solutions of varying concentrations in a conventional one-step process. Three or 4 moles of aluminum sulfate must be added per mole of phosphate to produce a phosphate concentration below 0.1 ppm. In a second experiment, a dosage of aluminum approximately equal to the amount of phosphate present was first added; after an hour for settling, 3 times the amount of phosphate remaining in solution was added to the filtered solution. Between 1.6 and 2.0 moles of aluminum per mole of phosphate initially present were required to produce phosphate concentrations below 0.1 ppm. Both experiments were conducted with sample pH between 4.5 and 7; even better results may be obtained above pH 7. The two-step process may be useful in removing phosphate from waste water with high phosphate content. Similar results were obtained in experiments using aluminum chloride instead of aluminum sulfate, except that the sample pH had to be adjusted to above 6.

*Chemical precipitation, *Phosphates, *Nutrient removal, Waste water treatment, Iron, Aluminum, Lime

Alum

D071
SEWAGE TREATMENT WITH ACTIVATED FLY-ASH AND REGENERATED ALUM SLUDGE,

Adhikari, M., Gupta, S. K., and Banerjee, B.

Calcutta University,
Calcutta, India,
University College of Science and Technology.

Journal of the Institution of Chemists (India), Vol. 47, Part 5, p 165-169, September, 1975. 1 tab, 18 ref.

The use of activated fly-ash/reclaimed alum sludge with a conventional coagulant in domestic sewage treatment was studied. Sewage water was treated with alum together with activated fly-ash, regenerated alum sludge, polyelectrolytes, or combinations of two agents; or with primary coagulant. Algae were enumerated and the presumptive coliform count was used to measure the bacterial population. Properly treated fly ash showed increased adsorption capacity and acted as a coagulating and flocculating agent. Polyelectrolytes and fly-ash showed a synergistic effect. Their use with alum for sewage treatment improves the efficiency of operation and increases the capacity of a given plant. The process also markedly reduced phosphate content, oxygen consumed, most probable number of coliforms, and total dissolved solids in treated water.

*Sewage treatment, *Coagulation, Polyelectrolytes, Bacteria, Adsorption, Flocculation, Solids removal

*Alum plus fly ash

D072
THE TYNESIDE SEWERAGE SCHEME,

Norgrove, W. B., and Staples, K. D.

Journal of the Institution of Water Engineers and Scientists, Vol. 30, No. 1, p 9-34, February, 1976. 6 fig, 1 tab, 5 ref.

Much of the sewage from Tyneside, Great Britain, is discharged into the River Tyne and its tributaries, without receiving any treatment. Tyneside's sewerage system is currently being improved to reduce the resulting pollution in the estuary. Interceptor sewers are being built along both sides of the river. Vortex-type overflows will be used to separate storm water, due to the super-critical flow velocities in many sewers. The treatment process will initially consist of screening, grit removal, and primary sedimentation; river water monitoring will determine what further treatment processes are necessary. Optimized design parameters for the aerated spiral flow grit tanks were determined by model analysis. They were designed with sewage entering at the surface perpendicular to the tanks with a maximum longitudinal velocity of 0.2 m/sec. The minimum retention time was 2.5 min, and the air supply was based on 0.28 cu m/min per m tank length. A surface loading figure of 36.5 cu m/sq m per day and a scour velocity of 31 mm/sec were used in designing the sedimentation tank. Sludge quantities were based on 0.07 kg/h/d for primary sludge and 0.11 kg/h/d for mixed sludge in 1975, and 0.08 kg/h/d and 0.12 kg/h/d for primary and mixed sludge, respectively in 1995. The Tyne Siphon was constructed to convey sewage from the Jarrow preliminary treatment works under the River Tyne to the Howden treatment works.

*Sewage treatment, *Treatment facilities, *Sewerage, Water pollution control, Sludge treatment, Waste water treatment, Rivers, Estuaries

Tyneside (Great Britain)

D073

MICROBIAL REACTIONS IN FACULTATIVE OXIDATION PONDS — I. THE ANAEROBIC NATURE OF OXIDATION POND SEDIMENTS,

Brockett, O. D.

Auckland University,
Auckland, New Zealand.

Water Research, Vol. 10, No. 1, p 45-49, 1976. 4 tab, 11 ref.

Volatile acid production, sulfide levels, and methane fermentation were compared in deep and shallow areas of faculative oxidation ponds. Acids were measured by the column partition chromatography method, and methane was collected by displacement with a filter funnel. Volatile acid utilizing sulfide producing bacteria and total sulfide levels were determined by standard methods. Volatile acids concentration, methane production, and sulfate reduction all showed significant increase with increase in pond depth. These results indicate the formation of better anaerobic conditions in the deep areas of the ponds. Gas collected in different areas of the oxidation pond system at different times had essentially the same composition, indicating the uniformity of the anaerobic nature of the ponds. Seasonal changes in volatile acid concentration occurred when biological organic matter from waste fed to the ponds during the winter months and from the pond biomass rapidly decomposed. The volatile acid content returned to lower levels after the load disappeared.

*Anaerobic conditions, *Methane, Oxidation lagoons, Microorganisms, Kinetics, Sulfide, Waste water treatment, Bacteria

Volatile acids

D074

PHOSPHATE REMOVAL—TACKLING EUTROPHICATION FROM THE OTHER SIDE,

Roberts, F.

Surveyor, Vol. 147, No. 4370, p 25, March 12, 1976.

While BOD removal has been the primary aim of waste water treatment in the United Kingdom, increasing attention in other European countries has been paid to phosphate removal and the control of eutrophication. Both nitrates and phosphates come from land drainage and sewage effluents. However, it is supposed that phosphates would be easier to control, since a larger proportion comes from the sewage effluent. Typically, 70% of nitrates comes from land drainage and 80% of phosphate from sewage effluent. Such countries as Switzerland, Sweden, and Canada have been developing phosphate removal as an integral part of sewage treatment. Phosphate control may be achieved either by reducing the phosphorus content of sewage (such as is done in Canada by requiring that detergents should have a substitute for NTA) or alternatively, by chemical treatment at the sewage works. This involves the use of lime, aluminum salts or ferric salts; the dose for alum could be about 150 mg/liter. The chemical may be incorporated at the beginning of treatment or as an additional process. The effect of phosphorus removal efforts on an already heavily enriched lake or inland waterway are not clear, but experts who treat phosphate problems in an acute form believe that the effort is worthwhile.

*Nutrient removal, *Waste water treatment, *Phosphates, *Nitrates, Eutrophication, Sewage treatment, Chemical precipitation, Flocculation, Water pollution control, Biochemical oxygen demand

D075

GRP LAUNDERS AT SEWAGE TREATMENT PLANT,

Reinforced Plastics, Vol. 20, No. 2, p 44-45, February, 1976.

New GRP launders and diffusers have been developed for use in sewage treatment plants. These plastics give increased strength and a high surface finish, with the incorporation of high density polyurethane foam in their sandwich construction. These launders, or trough-shaped conduits, had formerly been constructed of concrete and steel. With the lighter reinforced plastic construction, the equipment will be easier to transport and hoist and will discourage the growth of algae.

*Sewage treatment, *Equipment, *Plastics, *Construction materials, Waste water treatment, Corrosion control

Launders, Reinforced plastics

D076

WHO SAYS SEWAGE TREATMENT PLANTS HAVE TO BE UGLY,

Dinges, W. R.

Texas Department of Health Resources,
Austin,
Division of Wastewater Technology and Surveillance.

Water and Wastes Engineering, Vol. 13, No. 4, p 20-23, April, 1976. 2 tab.

Studies on the feasibility of using aquatic plants and animals to produce further reduction of undesirable suspended and dissolved substances from water following bacteria and algae treatment phases are being conducted at the Williamson Creek Wastewater Treatment Plant at Austin, Texas. The pilot system condists of an area of 0.14 acres divided into four ponds separated by crushed limestone rock barriers. Water hyacinths are cultured in the first two ponds while the last two ponds are used to permit the regrowth of other plant species and to evaluate the suitability of several fish species for consumption of vegetation produced. Water hyacinths accumulate heavy metals and trace organics from waters with contamination levels below detectable limits. The effluent from the hyacinth ponds is very clear and contains little total nitrogen. For the period June 1975 through January 1976, the average influent to the ponds contained 19 mg/liter BOD5, 70 mg/liter COD, 40 mg/liter total suspended solids, 1.3 mg/liter ammonia, and 14.7 mg/liter phosphate. During the same period, the average effluent from the pond system contained 3.2 mg/liter BOD5, 40 mg/liter COD, 6 mg/liter total suspended solids, less than 0.1 mg/liter ammonia, and 11 mg/liter phosphate. If the biomass produced in the hyacinth ponds is extrapolated to a one acre basis, then one acre would support a standing crop of an estimated 240 tons wet weight, or 12 tons dry weight and contain an estimated 4,500 pounds of mineral salts, 1,800 pounds of protein, and 16,800 pounds of carbohydrate.

*Sewage treatment, *Waste water treatment, *Biological treatment, *Aquatic plants, Nutrient removal, Floating plants, Water hyacinth

D077

VAN CLARIFIES SLUDGE OPTIONS,

Water and Wastes Engineering, Vol. 13, No. 4, p 51, April, 1976.

A clay-polymer clarification program developed by Nalco Chemical Company as an alternative to alum clarification was tested at two water treatment plants in Birmingham, Alabama. Sludge produced from clay-polymer clarification is much lower in volume than the sludge produced from alum clarification because no fluffy hydrated aluminum hydroxide is produced in the process. The clay-polymer sludge dewaters easily by drainage and evaporation; no chemically bound water is formed in the process. The city authorized Nalco to use its water resources management van to conduct evaluations of the clay-polymer program. The van can treat up to 100 mgd of water on the clay-polymer program. The van contains a laboratory equipped with a Zeta meter, spectrophotometer, pH instruments, turbidimeter, and colorimetric instrumentation. The results of the tests showed that the product water was of excellent quality, well within the city's standards, and that the process produced a low volume of sludge with good handling and dewatering properties.

*Water treatment, *Sludge treatment, *Clay, *Polymers, Dewatering, Sludge disposal

*Alum, *Clay-polymer sludge

D078

SEWAGE TREATMENT FACILITY TO BE UPDATED AND EXPANDED AT KITCHNER, ONTARIO,

Water and Pollution Control, Vol. 114, No. 1, p 23, January, 1976.

An extension to the Kitchener Pollution Control Centre facility in Ontario is described, which will bring the rated capacity of the plant from 11.5 million Igpd to 27 million Igpd. The facility is a conventional activated sludge plant with some original units that were built in the middle 1930's. Updating of the plant includes the building of a new overhead trunk sewer to bring raw sewage to the new plant; the demolition of the screen house and its replacement with a new screen and detritor building, capable of treating a peak flow of 43 million Igpd; and the upgrading of primary clarifiers, aeration units, and secondary clarifier units. New tanks are being designed for sludge treatment to mix and heat sludge with hydraulic gas guns. In addition, a new chlorine contact chamber is being added, which will provide a total detention time of 15 minutes a peak load. Other remodelling includes the replacement of the old boiler, the modification of the filter building to incorporate electrical and mechanical workshops, and the replacement of the present sludge lagoon area with a new sludge lagoon.

*Sewage treatment, *Treatment facilities, *Activated sludge, Sewers, Clarification, Equipment, Aeration, Sludge treatment, Chlorination, Construction, Lagoons

Treatment facility upgrading, Ontario (Canada)

D079

WEED HOLDS PROMISE FOR POLLUTION CLEANUP,

Chemical and Engineering News, Vol. 54, No. 12, p 23-24, March 22, 1976.

The water hyacinth is being tested as a means of sewage treatment for small towns which can not afford the capital investment necessary with conventional treatment techniques. The water hyacinth is a vascular plant containing a system of vessels that transport nutrients from the roots through the leaves while absorbing large quantities of nutrients and pollutants found in domestic sewage. The hyacinth also has the ability to concentrate heavy metals and organic substances often present in industrial wastes. National Aeronautics and Space Administration (NASA) officials have been conducting research at Bay St. Louis, Mississippi. In the spring of 1975, three acres of a 40-acre municipal lagoon that receives raw sewage from about 6000 households was planted with water hyacinths. Although the three acres was insufficient to clean up the entire lagoon, planting 12 acres of the lagoon with hyacinths in summer of 1976 is expected to produce clean water in the lagoon. Uses for water hyacinths produced are also being explored. In a study at the Mississippi State University agricultural experiment station, hyacinths grown in municipal sewage were dried, ground into meal, and added to cattle feed. The hyacinth meal is high in minerals and protein and is comparable to cottonseed meal or soybean meal as a feed supplement. NASA is researching the conversion of water hyacinths into methane by anaerobic fermentation. Residue produced by anaerobic digestion is an efficient fertilizer and soil conditioner.

*Sewage treatment, *Waste water treatment, *Water hyacinth, Aquatic plants, Floating plants, Biological treatment, Lagoons

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D080

CARBON WASTEWATER TREATMENT PROCESS,

Humphrey, M. F., Dowler, W. L., and Simmons, G. M.

California Institute of Technology,
Pasadena,
Jet Propulsion Laboratory.

Public Works, Vol. 107, No. 2, p 62-63, February, 1976. 1 fig.

It formerly was considered cheapest to dispose of sewage sludge. Now sludge can be recycled, producing methane and an activated carbon, used to purify more waste water. Many new processes use activated carbon to absorb contamination with or without chemical coagulating agents. In this new process, after the carbon adsorbs dissolved solids from water, it is recycled back into the untreated sewage and removed along with the sludge. Critical aspects of the process include using primary sludge solids to produce adsorbent carbon char and using it for promoting separation of suspended and settleable solids. After preliminary laboratory investigations of these steps and using the carbon char for removing dissolved solids, a pilot plant was designed, constructed, and placed in operation. The process involves absorbing most of the liquid wastes with the ash and carbon, and drying the mixture more completely and faster than is done in other processes, without adding any chemical agent. The pilot-plant demonstrated the potential to meet or exceed the federal and state requirements for water-disposal quality. Economic studies in progress indicate higher effluent qualities at costs competitive to those of conventional biological processes.

*Waste disposal, *Sewage sludge, *Recycling, Activated carbon, Methane, Adsorption, Solids removal

D081
COTTONVALLEY -- BRITAIN'S LATEST SEWAGE WORKS,

Water Services, Vol. 80, No. 959, p 49, 51, January, 1976.

The Cottonvalley Sewage Works, now under construction to serve all the needs of the new city of Milton Keynes, is designed to the same standards as other parts of the city as an integral part of the area. The works are expected to eventually serve a population of 275,000, including another town and surrounding villages, and will probably be completed by 1990. The Cottonvalley scheme is believed to be one of the most advanced purification works of its type anywhere in the world. The first of the three phases, designed to serve a population of 117,000, is nearing completion. Methane gas from sludge digestion is the main fuel for the two boilers and the sludge incinerator. When the incinerator is in use, heat from its waste gases is recovered by a heat exchanger for sludge digestion, heating domestic hot water, and space heating; at other times, these functions are assumed by the boilers. Administrative and laboratory areas are air conditioned. Building services are pneumatically controlled from a central panel.

*Sewage treatment, *Treatment facilities, Tertiary treatment, Methane, Incineration, Sludge treatment

D082
REVERSE OSMOSIS -- CAN IT REPLACE DISTILLATION?,

Frith, C. F.

Chemical Processing, p 19, 21, January, 1976. 3 fig, 2 tab, 8 ref.

Consolidating engineering, production, and maintenance personnel in treatment plants has improved efficiencies, but quality is more variable. Central system maintenance affects every user, downtime stops all production, the method of sanitizing or chemical cleaning may adversely affect special end products, the main system's quality problems have tremendous implications for every process that requires water and, most importantly, those processes for which superior quality is justified are often compromised by emphasis on budget restrictions. For these reasons, compact, point-of-use reverse osmosis (RO) systems were developed. The Milli-RO 15, a 15 liter/hr system operating from municipal supply, can be quickly converted into a 4 liter/hr unit by replacing the reverse osmosis cartridge, or modified to increase production rates by adding a pump module. Milli-RO systems employ prefilter and reverse osmosis modules, with a pump module between the two in the Milli-RO 40. Reverse osmosis removes many contaminants. These units can be selected, installed, and operated at the point-of-use, allowing control by the user. Eighty liters/hr can be produced by increasing pressure. Replacing the cartridge in a very short time when the system had been fouled was an important advantage to one user whose feed water quality was very poor. RO is satisfactory as an alternative to the traditional distillation method for purifying water.

*Reverse osmosis, *Filtration, *Waste water treatment, Treatment facilities, Membrane processes

D083
SLUDGE/ACTIVATED CARBON CYCLE TREATS SEWAGE,

Industrial Research, p 30, 33, January, 1976. 1 fig.

If a pilot plant achieves projected 25% savings in costs, a new concept in technology for sewage treatment could be extensively used in treatment plants. A pyrolysis unit to manufacture activated carbon, for which sewage solids made a very good raw material, led to the use of the activated carbon produced to further treat waste water. This approach solves a problem common to most municipal sewage plants providing only primary treatment. The new process makes the solids that are normally difficult to dispose of into activated carbon, which is recycled with new solids and reactivated after use. Comparison studies found rotary calciners to be the best approach for the pyrolytic reactor. Data from a pilot plant test were used in designing the calciner being prepared for a million-gallon-a-day pilot plant at Huntington Beach, California. A gas drier is included to take exhaust gases from the burners to a flash drier to dry the filter cake before it goes into the calciner.

*Pilot plants, *Activated carbon, *Activated sludge, Recycling, California

*Pyrolysis

D084
CRAWLEY SEWAGE TREATMENT WORKS,

Water Services, Vol. 80, No. 959, p 39, January, 1976. 1 tab.

A plant for tertiary treatment is operating successfully at Tinsley Green. The treatment works, located near Crawley, was formerly under the control of the Crawley Urban District and now comes within the Thames Water Authority. The ever increasing demands on the original plant made it necessary for further extensions to be built; the tertiary treatment incorporates six gravity filters with equipment for automatic operation. The tertiary treatment plant was designed for dry weather flow of 23.64 million liters per day and peak flow of twice that amount. It was designed to treat sewage effluent already treated to the standards of the Royal Commission to under 10.0 ppm suspended solids and 5 day biochemical oxygen demand (BOD) in summer and under 15.0 ppm in winter. The influent and the final treated effluent were tested during mid 1974; the standards were met. Equipment for sequence control and automatic filter washing was designed to allow automatic washing of the filters when either a pre-determined head loss through the filter occurred or a predetermined filter run terminated.

*Tertiary treatment, *Treatment facilities, *Sewage treatment, Biochemical oxygen demand, Suspended solids, Filtration

D085

SOME CRITICAL VIEWS OF SELECTED PROCESSES FOR THE BIOLOGICAL TREATMENT OF SEWAGE,

Schmidt-Holthausen, H. J.

Process Biochemistry, Vol. 11, No. 2, p 27-30, March, 1976. 4 fig.

Although the aerated sludge process always uses an aeration tank followed by a final settling tank, there are many variations in the way in which sewage, oxygen, and activated sludge are brought into contact. In two process methods, raw sewage and activated sludge are completely and immediately mixed throughout the tank. One of these uses fine bubble aeration, while the other uses surface aerators. The piston flow feed method also provides complete mixing, but sludge loading decreases and oxygen concentration increases in the direction of flow. Another method feeds return sludge at the inlet end of the tank and sewage and sludge along the lateral sides. The Bioxon process includes incremental sewage feed and tapered feed of air along the lateral sides of the aeration tank. Activated return sludge is fed at the inlet end, resulting in a very high concentration of solids at the front of the tank. This high concentration leads to increased biological activity and metabolism, requiring an increased oxygen demand which is met by tapered aeration. Pure oxygen has been used for aeration in pilot plants. The advantages of using pure oxygen are offset by the disadvantages. The three main methods of using pure oxygen include the Marox process, which uses very fine bubbles and an open tank. The Unox process uses several tanks, and feeds the oxygen from the gas space above one tank to the next tank. The Lindox process uses a blower to recirculate oxygen not used. The most suitable activated sludge process must be selected for each application.

*Activated sludge, *Treatment facilities, *Aeration, *Waste water treatment, Oxygen, Bubbles

Aerators, UNOX, Bioxon, Marox, Lindox, High-purity oxygen

D086

OZONE PROVIDES ALTERNATIVE FOR SECONDARY EFFLUENT DISINFECTION. PART 1,

Nebel, C., Gottschling, R. D., Unangst, P. C., O'Neill, H. J., and Zintel, G. V.

Welsbach Ozone Systems Corporation,
Philadelphia, Pennsylvania.

Water and Sewage Works, Vol. 123, No. 4, p 76-78, April, 1976. 7 fig.

Previous work has established that the effectiveness of ozone in secondary sewage effluent disinfection can be considered at several dosage levels. This study investigated the dosages of ozone required for disinfection in order to determine the effectiveness of removal of specific contaminants in the effluent. Secondary effluents were obtained from three types of sewage treatment plants in New Jersey and Pennsylvania—standard activated sludge, contact stabilization, and pilot plant oxygen enriched activated sludge. Effluents were ozonized in a 6.5 inch I.D. Plexiglas ozone contact column. Samples were removed at specified times and analyzed for contaminant concentration. The amount of ozone required was found to vary, depending on the exact nature of the effluent. Data showed that the existence of ozone reaction products may be correlated to bacterial kill. A peroxide residual may be calculated as a quasi ozone residual, and may be used for the automatic control of an ozone disinfection system in an application similar to that of the chlorine residual method.

*Sewage treatment, *Disinfection, *Ozone, Waste water treatment, Tertiary treatment, Treatment facilities, Bacteria, Design criteria, Activated sludge

D087

WORKING TOWARDS TOUGHER ODOUR CONTROL STANDARDS,

Process Engineering, p 95, February, 1976.

Due to anticipated stricter standards of control for odors from industrial and municipal sources, new technology is being considered in the United Kingdom. Available new equipment includes the high-efficiency KT fume scrubber from Plastic Constructions, a series of ozonators developed by Wallace & Tiernan, and Aeronca's closed-circuit drying system based on its Impinjet scrubber which could prove suitable for the control of escaping dust, vapor and odor. Detailed is the development of the Var "wet" odor oxidation process using ozone. By scrubbing foul air with ozonated water, oxidation occurs and contact time is reduced to three seconds compared with 30 seconds for "dry" ozonation. Ozone does not need to be applied in excess. The Var system is currently being installed at two sites near Edinburgh--the Seafield sewage treatment works and Leith Docks. It will be used to treat odors from sludge storage tanks at about 25,000 cu m/hr. The system is also suitable on an industrial scale for gases extracted from individual processes or as a high-volume polishing process on air extracted from an entire facility. A pilot scale test plant has been operating for over a year, treating the very difficult odor from a fish meal plant; performance has been reported to be very encouraging.

*Odor, *Sewage treatment, *Waste water treatment, Municipal wastes, Food processing industry, Ozone, Oxygen

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D088

DESERT AREA ACTIVATED SLUDGE PLANT,

Public Works, Vol. 107, No. 2, p 86, February, 1976.

The Indio, California, waste water treatment plant in the Southern California desert serves a population of 25,000 and industry. It includes primary and secondary settling, conventional activated sludge treatment, wet air oxidation of sludge, and chlorination. Diffused air aeration is important to proper operation of the activated sludge treatment process and, due to the high ambient temperatures, capability of the air compressor is more important than is usually true. Peak temperatures require higher air volumes. Two centrifugal blowers for normal operation are powered by electricity, and a third, which serves as a standby, is powered by an engine fueled by natural gas. The only unusual difficulties in nearly 2 yr of operation have been occasional sand storms that cause some problems in the lines.

*Waste water treatment, *Activated sludge, *Treatment facilities, Sludge treatment, Chlorination, Equipment

Wet air oxidation

D089

ACTIVATED SLUDGE PROCESS WITH ALUM ADDITION AND HEAT TREATMENT,

Gray, A. C., Jr., Gerber, H. B., and Paul, P. E.

Journal Water Pollution Control Federation, Vol. 48, No. 1, p 163-178, January, 1976.
9 fig, 7 tab, 12 ref.

Combined high-purity oxygen activated sludge, phosphorus removal by aluminum sulfate precipitation, and thermal conditioning all sludges were studied for Harrisburg, Pennsylvania. Separate on-site pilot systems were used for the oxygen activated sludge and thermal conditioning processes. Treated primary effluent from existing facilities by high-purity oxygen activated sludge, under 2.0 hr aeration time produced < 20 mg/liter effluent biochemical oxygen demand (BOD) concentration, even during storm loadings. At 0.5 lb BOD/day lb mixed liquor suspended solids (SS) biomass loading, 1.08 lb total solids/lb BOD removed were produced. An average 1.31 lb oxygen were consumed/lb BOD removed. Solids production varied directly and oxygen consumption inversely with biomass loading. Phosphate was removed to effluent concentrations of < 6.0 mg/liter total and 3.0 mg/liter soluble phosphate with aluminum sulfate. About 1.8 mole aluminum ions/mole phosphorus was the optimum dosage, equivalent to adding about 5.6 lb alum/lb influent phosphate. It is necessary to acclimate the biological system to the alum, or the effluent phosphate will increase due to the SS increase. Mean SS concentrations in the effluent were < 20 mg/liter before chemical addition at rates of clarifier surface loading between 641 and 694 gal/day/sq ft. Effluent SS increased and observable pin floc formed in the final clarifier after alum addition. For this reason the final design includes polyelectrolyte addition. Thermally conditioning combined sludge increased dewaterability. Filter yields between 3 and 9 lb/day/sq ft and optimum dewatering were compatible. Decant liquor from thermal sludge conditioning did not change effluent quality. While the pilot plant operated, up to 30% of the oxygenation tank's BOD loading was recycled decant liquor. Recycled liquor will probably account for between 10 and 15% of the BOD loading to the oxygenation tanks in the full-scale system.

*Waste water treatment, *Activated sludge, *Treatment facilities, Phosphorus, Nutrient removal, Sludge treatment, Polyelectrolytes, Dewatering, Heat treatment

Alum, High-purity oxygen, Sludge conditioning

D090

SOLUTION OF THE OPERATING PROBLEMS OF A MODERN SEWAGE TREATMENT PLANT,

Finch, J.

Berichte der Abwassertechnischen Vereinigung e.V., No. 28, p 207-214, 1976.

Possible solutions to various water pollution control problems were introduced into a modern sewage treatment plant at Slough, Great Britain, with very satisfactory operational characteristics. The plant uses reinforced fiberglass in the settling tank outlet trough/weirs. An aeration tank with a dynamic baffle-wall performed very similarly to a conventional tank, but cost less to construct. The floating roof type heated sludge digestion tanks were improved by installing a high-density polyethylene pipe line along the peripheral walkway at the top of the tank and blowing gas through spargers inserted between the floating roof and the digester sidewall. Partially dewatered sludge from the heated digestion plant, containing appreciable quantities of phosphorus and nitrogen, is used to fertilize grassland on which beef cattle are grazed. Sludge, soils, crops, and animals are monitored. The increasing demand for water requires improved quality of effluents discharged into rivers. In one instance, improved treatment was achieved by spreading the release of an industrial effluent into the sewage system over a longer period of time. Primary settlement may also achieve a good deal of balancing at the treatment plant. However, there has been little study of incorporating balancing into treatment plant operation. The Slough plant is essentially a high-rate surface aeration unit followed by nitrifying biological filters. It incorporates balancing by extended use of augmented existing storm water tanks to cut off peak flows and store and return them to fill in troughs at low flow. It is easier, more satisfactory, and less expensive to build automation into a process involving balancing.

*Waste water treatment, *Treatment facilities, *Sewage treatment, Aeration, Sludge digestion

D091

A COMPARISON BETWEEN THE EFFICACY OF SUBMARINE OUTFALL DISPOSAL OF ADVANCED PRIMARY EFFLUENT AND CONVENTIONAL TREATMENT,

Olivotti, R.

Trieste University,
Trieste, Italy,
Istituto di Idraulica.

Berichte der Abwassertechnischen Vereinigung e.V., No. 28, p 215-231, 1976. 2 tab, 55 ref.

The optimum choice of systems for treating and disposing of waste water in coastal areas depends on local circumstances. Types of systems frequently used include a long outfall preceded by pretreatment, a long outfall preceded by primary treatment, and biological treatment and chlorination followed by discharge near the coast. Advances which do not substantially change the problem's financial dimensions include the use of advanced primary treatment and following chlorination with dechlorination after biological treatment. Either of the latter two systems can usually meet a requirement that the 80th percentile be less than or equal to 100 fecal coliforms/100 cu cm. Viruses must also be considered as contaminants. Both of these systems can provide satisfactory protection against pollution by viruses, but outfalls must be longer than the current usual length. A long outfall preceded by advanced primary treatment is more effective against eutrophication. Both systems can result in satisfactory water quality near the outlet. Where the minimum prescribed treatment is not higher than advanced primary, either system may be used. The long outfall method, however, cannot be used where biochemical oxygen demand (BOD) standards are strict. Costs of the two systems are usually of the same order. Long outfalls preceded by advanced pretreatment are often preferable when concentrations of dissolved persistent toxicants meet specific standards and conventional 'full' treatment is not legally mandatory.

*Waste water treatment, *Waste water disposal, *Pre-treatment, *Outfall sewers, Nutrient removal, Viruses, Biochemical oxygen demand

Marine outfalls

D092

OBJECTIVES AND COSTS OF ADVANCED TREATMENT TECHNIQUES FOR SEWAGE,

Truesdale, G. A., and Taylor, M. R. G.

D. Balfour and Sons, Consulting Engineers,
London, Great Britain.

Berichte der Abwassertechnischen Vereinigung e.V., No. 28, p. 323-332, 1976. 1 fig, 24 ref.

The uses of the receiving watercourse largely determine effluent standards. Controlling discharges of suspended solids and oxygen consuming matter is fundamentally important. Tertiary treatment is used to meet more stringent standards. Irrigation over grassland is such a process; effluent is allowed to flow over graded land with a gentle slope, then collected. Lagoons are another such method. Slow filtration through sand is suitable for small works. Rapid sand filtration uses thicker layers of sand, and the liquid may flow either up or down. Microstraining forces effluent through a cylindrical surface of stainless steel fabric, in which solids collect. In gravel bed clarifiers, effluent flows upward through a shallow gravel bed. A suitable tertiary treatment process can achieve effluent standards of 10:10. Percolating filters operating at relatively low biochemical oxygen demand (BOD) loadings normally achieve a high degree of nitrification for ammonia removal. Biological nitrification followed by denitrification seems most promising for removing nitrogen in the form of nitrate. Alum, lime, or iron salts can remove phosphate by precipitation, either during primary treatment or as a tertiary process. Biological methods can produce effluents with 5 mg/liter BOD, suspended solids, and ammonical nitrogen, but could probably not meet more stringent standards. Activated carbon adsorption can remove residual organic matter, but not inorganic constituents. Ion exchange usually requires activated carbon pretreatment to remove organic matter, as would electrodialysis. Much of the data on costs of these processes is based on limited operating experience.

D093

CARBON MADE FROM SEWAGE SOLIDS TREATS WASTEWATER,

Water and Pollution Control, Vol. 114, No. 1, p 31, January, 1976.

A pilot plant is being constructed to test a system that uses a pyrolytic reactor for converting solid sewage materials into activated carbon, which then is used to treat incoming waste water. A mobile demonstration unit operated successfully at the sewage treatment plant at Huntington Beach, California, where the pilot plant will be installed. The system, as tested with the mobile unit, virtually eliminated sewage solids, delivered cleaner waste water to the ocean, removed heavy metals from the sewage, and eliminated odors. Design parameters will be determined by the pilot plant for larger facilities processing sewage to meet pending United States environmental standards. The origin of the process was a pyrolysis unit to manufacture activated carbon. Later it was found that sewage solids were a very good raw material, and the resulting product was suitable for further treatment of sewage. After treating the waste water, activated carbon is recycled with the new sewage solids and reactivated. Eventual extraction of some ash and carbon from the process represents the system's only residue.

*Waste water treatment, *Activated carbon, Pilot plants, Sewage treatment, Suspended solids, Heavy metals, Odor

*Pyrolysis, Sewage solids, Activated carbon manufacture

D094

NITRATES: WHAT'S HAPPENING IN BRITAIN?,

Ray, W.

Thames Water Authority,
London, England.

Water and Wastes Engineering, Vol. 13, No. 4, p 26-28, 30, 48, April, 1976. 3 fig.

Demand for water has increased, resulting in increased use of water from rivers. Increased detergent use and improved techniques for sewage treatment which oxidize ammonia are partially responsible for increases in phosphate and nitrate concentrations in natural waters. The major source, however, is agricultural fertilizer run-off. Nitrates cause most concern in the River Lee, an important tributary of the River Thames. Measures were taken to reduce the nitrate level in the effluent of a major sewage treatment works on the River Lee, at Rye Meads North of London. Laboratory work indicated that an anoxic zone in activated sludge plants could reduce the nitrogen concentration in the final effluent by about 40% under the proper conditions. Plant scale experiments are in progress. Attempts to create an anoxic zone by removing 75% of the diffusers to reduce air action to a level preventing settling were not entirely satisfactory; either some settlement occurred or a slightly greater air flow inhibited anoxic conditions. Substituting a stirring mechanism for the diffusers reduced nitrate from 29 mg/liter to 16 mg/liter in the final effluent. The original design of a new works at Borden, south of London, included denitrification based on these methods. Another new plant being constructed in the River Blackwater Valley near Farnborough provides in its original design for introducing settled sewage upstream of the aerators, creating a zone facilitating denitrification. Both methods are based on nitrate as an oxygen source for various facultative heterotrophic bacteria. Methanol was studied experimentally as a source of carbon for the biological process at Lee Bridge. Nitrate removal rates were consistently 70% to 90%. A new ion exchange process, using heated influent rather than an acid or base solution has been studied but not used commercially.

D095

PCS USES STUDY APPROACH FOR EFFLUENT TREATMENT,

Chemical Age, Vol. 112, No. 2950, p 15, January 30, 1976. 1 fig.

Pollution Control Systems (PCS) builds effluent plants, provides technical assistance, and studies the economics of treating effluent and recovering materials. PCS uses a set method in approaching effluent problems. First a study involving both field work and analysis is conducted, technically assessing the scale and nature of the problem. A process design team then considers hydraulic levels, pollution levels, and required discharge standards, and proposes a treatment system. Various products for low rate filtration and biofiltration and two treatment systems are currently available from the company. A deep shaft process was developed for biologically treating biodegradable industrial effluent or sewage. It supplies air more efficiently to micro-organisms, significantly increasing treatment rates. The microflotation process, licensed to PCS, couples the benefits from chemical flocculation technology and a simple air bubble generation method for removing suspended solids by flotation. First, oversized solids are removed, the effluent pH is adjusted, and any chemical precipitants required are added. Hydrostatic pressure dissolves air which is injected, aerating the effluent. Reduced hydrostatic pressure later releases the dissolved air as microscopic bubbles which float the stream's solid particles, to which they attach themselves, to the surface.

*Waste water treatment, *Treatment facilities, Biological treatment, Filtration, Flotation, Sanitary engineering, Bubbles

Deep Shaft Process, Microflotation

D096

NITRIFICATION STUDIES OF SHIP CHANNEL WATERS,

Hung, Y. T., and Eckenfelder, W. W., Jr.

Texas University at Arlington,
Department of Civil Engineering.

Water and Pollution Control, Vol. 114, No. 4, p 8-9, 11, 46-47, April, 1976.
4 fig, 2 tab, 5 ref.

A study was conducted on the Houston Ship Channel water to determine the nitrification of channel water samples and the effects of channel flow and degree of treatment on the nitrification process under simulated laboratory conditions. Houston Ship Channel water from various depths was aerated in the laboratory for 20 days and sampled every few days for nitrate and nitrite analysis. Simulation was performed by adding fresh water and waste water to a drum in proportion to the flow in the channel, and sampling before and after each input. Nitrification was not observed in the Houston Ship Channel waters at station Mile 10, the sampling location. This situation might be caused by the absence of dissolved oxygen in the channel waters. Nitrification of water samples taken in August at the same location started on the 12th day of aeration in the laboratory, with a nitrogenous biochemical oxygen demand (BOD) of 9.1 mg/liter. For samples taken in September, nitrification started between the 3rd and 7th days of aeration with a nitrogenous BOD of 0.7 to 1.8 mg/liter. The simulation seems to indicate that the degree of waste treatment increases nitrification, whereas the increase in channel water flow leads to a lesser extent of nitrification.

*Nitrification, *Rivers, Flow, Waste assimilative capacity, Self-purification, Nitrates, Nitrites, Dissolved oxygen, Nitrogen compounds

Houston Ship Channel (Tx)

D097

THE WATER INDUSTRY: A REIVEW RELATING TO WASTE WATER TREATMENT,

Kershaw, M. A.

Process Biochemistry, Vol. 11, No. 2, p 37-39, 44, March, 1976. 14 ref.

The Water Resources Act of 1973 restructured water services in England and Wales to meet increasing demands for water, improve quality of effluent discharges, and protect fisheries and water amenities. In April 1974, 10 regional water authorities replaced 1600 separate bodies. Clean rivers and augmented water supply both depend on sewage and effluent treatment. Many of the actual sewage works inherited from local authorities were grossly overloaded and had worn out equipment. Because of this situation, research on improved waste water treatment is being conducted with a sense of urgency. Continuous monitoring of the stages of waste water treatment is emphasized because of the danger to fish posed by instantaneous discharges. Attempts are also being made to link weather conditions more closely with water treatment. There are many variations in sewage treatment processes, including small prepackaged units. In many instances, increasing pressures for improved effluent quality require further stages of treatment, tertiary treatment for effluents already of good quality or advanced treatment, beyond the traditional methods. Advanced treatment methods usually involve further removal of suspended solids, chemical treatment, and removal of organic materials with activated carbon. Methods for removing dissolved salts include ion exchange, electrodialysis, and reverse osmosis. Well-digested sludge that does not contain residual heavy metals can be used as agricultural fertilizer. Automatic control is being used increasingly for routine operations. In some cases, industrial wastes are being recycled into new products.

*Waste water treatment, *Sewage treatment, *Tertiary treatment, Ion exchange, Electrodialysis, Reverse osmosis, Fertilizer, Treatment facilities

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D098

DEVELOPMENT OF A CONTINUOUS INCLINED SAND BED FILTER,

Allanson, J. T., and Austin, E. P.

Simon-Hartley Limited,
Stoke-on-Trent,
Great Britain.

Filtration and Separation, Vol. 13, No. 2, p 165-166, 168-169, March-April, 1976. 6 fig, 5 tab, 3 ref.

A low-cost continuous filter has been developed which employs a moving sand bed in which the flows of sand and water have been arranged to minimize the possibilities of blockage. Sand is withdrawn from the center of the bottom of a cylindrical container, creating an inclined surface with the largest particles at the lowest part in the center. Liquid enters at the center and leaves from the periphery, and the sand withdrawn is cleaned and added to the edge at the top of the container. A laboratory bench model, a pilot filter, and a prototype filter were tested. The results from all were satisfactory. The laboratory model removed equal or greater amounts of suspended solids when compared to a static sand bed. The pilot filter was tested on the overflow from the biological treatment plant humus tanks at a paper mill and the final effluent from a mechanical-aeration plant treating mainly domestic sewage. Techniques for backwashing the filter were developed in case a slug of solids should enter the filter. The prototype filter was similar to the pilot plant, but larger, and it operated similarly. A standard range of such filters has been designed, using the diameter of the filter as the basic dimension. This type of filter saves civil engineering costs as compared to rapid gravity and pressure filters, because it operates continuously and therefore does not need storage facilities for use while backwashing. In a specific example analyzed, the motor horsepower needed for the pump was less than for either of the other systems, and, unlike the other systems, no automatic control was required.

*Filtration, *Laboratory tests, *Suspended solids, *Sewage treatment, Equipment

D099

THE OPERATION OF A SIMPLEX ACTIVATED SLUDGE PILOT PLANT IN AN ATMOSPHERE OF PURE OXYGEN,

Wood, L. B., King, R. P., Durkin, M. K., Finch, H. J., and
Sheldon, D.

Greater London Council,
London, Great Britain,
Scientific Branch of the Director General's Department.

The Public Health Engineer, Vol. 4, No. 2, p 36-43, March, 1976. 2 fig, 4 tab, 10 ref.

Replacing air with oxygen in the activated sludge process has been studied. In the first stage of the work, two sludges were treated at retention times of 4 to 8 hr at a small modified diffused air pilot plant. The second stage, using an adapted single aerator plant, included the following phases: preliminary studies to gain experience with the pilot plant; chemical adjustment of the mixed liquor pH; acclimatization of nitrifying sludge from a diffused air plant; operation with a nitrifying sludge; studying the mixed liquor suspended solids (MLSS) build-up rate by operation without withdrawing sludge; comparing retention times of 6.9, 3.9, 2.4, 1.7, and 1.2 hr, including nitrification and ratio of volatile suspended solids (VSS) to total suspended solids (TSS) at different retention times; treatment of crude sewage; and addition of ferric iron. Replacing air with oxygen did not increase the growth rate of organisms responsible for carbonaceous and ammonia oxidation or their oxidation rate for a unit mass of organisms. The maximum growth rate of Nitrosomonas can be reduced in single stage systems by low pH in mixed liquor where the latter is enclosed with oxygen, and carbon dioxide allowed to build up in the gas space. However, the greater facility provided by oxygen use in allowing high MLSS concentrations to be maintained, offers the possibility of greater hydraulic loading and smaller volumetric capacity for plants aimed only at removal of biochemical oxygen demand (BOD) load. Sludge quantity was not reduced. The growth rate of organisms oxidizing carbonaceous substrate was similar to that with air-based sludge and produced a similar sludge yield. Generally sludge settlement, as measured by the standard procedure and used to calculate linear settlement rate, revealed no special advantage to oxygen use.

*Sludge treatment, *Activated sludge, *Aeration, *Oxygen, Pilot plants, Nitrification, Biochemical oxygen demand

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D100

WASTEWATER TREATMENT IN NEW ZEALAND,

Gunn, I. W.

Auckland University,
Auckland, New Zealand,
Department of Civil Engineering.

The Public Health Engineer, Vol. 4, No. 2, p 49-55, March, 1976. 1 fig, 7 tab.

Considerable experience has been gained in the design and operation of treatment plants for a population of less than 5000 in New Zealand. Public sensitivity to effluent discharge is high, since most population centers are near major rivers or the coast, and estuaries and coastal waters are used for recreation and shellfishing. Farm wastes posing pollution problems include artificial fertilizers as well as animal wastes. Meatworks and dairy factories have been slower than municipalities to invest in pollution control equipment, although this type of industry produces a greater waste load. Individual household disposal systems designed according to the 1961 Codes of Practice have not been successful, and such individual systems are discouraged. The 'Imhoff' tank has been widely used for settling and sludge stabilization in small plants prior to biological treatment. Variations of the 'Pasveer Ditch' process have been used in some areas. Package plants are used in a few communities and for private treatment plants; extended aeration is the most common process. Lagoons are the most widely used method of treating community waste water. Fifteen communities use tertiary treatment after conventional biological treatment, predominantly bacterial reduction lagoons. Most treatment plants are designed empirically, with allowance for future growth. The Central Government runs programs to train operators.

*Waste water treatment, *Design, *Treatment facilities, Industrial wastes, Biological treatment, Water pollution control

D101
OPERATION OF OZONE TREATMENT APPARATUS (Ozone shori sochi no unten),

Takaya, K.

Suido Kyokai Zasshi, No. 497, p 38-49, February, 1976. 23 fig, 5 tab, 8 ref.

The ozone treatment facility at the Kurashiki Water Works, Japan, for the deodorization of undesirable odors in the drinking water is described. The actual treatment facility was constructed after basic data collection at an experimental plant. The facility treated a maximum of 30,000 cu m/day river water which was first treated by a rapid filtration method, and entered into an ozone reaction bath. The residence time of water in the reaction bath was 3.3 minutes and a diffusion method for the ozone and water contact was employed. The ozone absorption efficiency and the ozone level in the exhaust gas from the reaction bath agreed in both the experimental plant and the actual facility; ozonized air flow rate was 252 cu m/hr. With the ozone concentration in the flowing air at 1.5 ppm, ozone absorption efficiency by water was about 70% and ozone concentration in the exhaust gas was about 1.6 g/cu m air. Residual ozone from the reaction bath was treated with activated carbon. The dissolved ozone concentration in the water during winter treatment was almost twice that of summer treatment, due to water temperature. Treated water was stored in a pool before being sent into the water main and no residual ozone was found in the water of the water main. The deodorization effect achieved was a decrease in the threshold odor unit from 10 for the pre-treatment to 4 after the treatment. Operational costs of deodorization were 1¢ per cu m water.

*Odor, *Ozone, *Water treatment, *Potable water, Rivers, Treatment facilities, Laboratory tests, Pilot plants, Costs

Japan

D102
FLUIDIZED BED TO HANDLE COMBINED WASTE SLUDGES,

Public Works, Vol. 107, No. 5, p 108, May, 1976. 1 fig.

The waste water treatment facility being built for the Tyrone Borough Sewer Authority in Blair County, Pennsylvania, has been designed to receive white-water sludge from a nearby paper mill. The plant is modular design, will include space-saving features to accomodate plug flow or complete mix operation, and is flexible enough for varying industrial and seasonal changes. Solids load is expected to be 7900 lb/day primary sludge and 3100 lb/day secondary sludge at full capacity. Sludge, both primary and secondary, will be dewatered in a fluidized bed process, by means of a solid bowl centrifuge with the aid of a cationic polymer. In the fluidized bed reaction, fluidizing and combustion air are preheated to 1000 F by extracting waste heat from the reactor gases. Excessive particulate emissions in the exhaust gases are prevented by a high-energy wetted wall venturi scrubber followed by a packed secondary scrubber-cooler.

*Sludge treatment, *Waste treatment, *Industrial wastes, *Pulp and paper industry, Municipal wastes, Treatment facilities, Dewatering, Centrifugation, Design criteria

Fluidized bed reactor, Municipal-industrial wastes

D103
VALUE ENGINEERED SEWAGE PLANT MOVES FAST,

Engineering News-Record, Vol. 196, No. 17, p 22, April 22, 1976. 2 fig.

Time and cost savings were effected in the value engineered construction of a sewage treatment plant in Concord, California. The 30 mgd tertiary treatment plant will recycle effluent from an upgraded secondary treatment plant, producing industrial cooling and process water. Due to weather and other delays, the project began behind schedule. Engineers agreed to change the foundations specification for the structure set in clayey soil when a sand lens was located about six feet below the elevation of the valve structure floor slab. The sand lens was an acceptable bearing for the structure, and excavation of only 21 feet in depth needed to be made. With the raised elevation, open cutting could be performed on three sides for the excavation on a 1.5:1 slope to install the outfall line. By eliminating the building of a cofferdam for excavation, work was completed in one, rather than five weeks. Other innovative construction techniques included the shop fabricating of 18 to 72-inch steel piping, rather than field welding; the preassembly of intake and discharge manifolds up to 60 ft long and 30 ft high; and the use of modular steel panels to assembly forms for placing wall structures.

*Costs, *Construction, *Sewage treatment, *Treatment facilities, *Tertiary treatment, *Construction materials, Engineering, Design criteria

Value engineering

D104
MICROBIAL ASPECTS OF CARBONISATION EFFLUENT TREATMENT,

Stafford, D. A.

Effluent and Water Treatment Journal, Vol. 16, No. 3, p 136-137, 139, March, 1976.
20 ref.

Microorganisms can readily utilize compounds from carbonization liquors as energy and carbon sources. Carbonization liquors also provide elemental sources for biosynthesis. Due to their biochemical potential, microorganisms are ideally suited for the chemical transformations necessary to mineralize the organic and inorganic compounds of carbonization liquors. The predominant bacteria in the activated sludge treatment of carbonization liquors include Pseudomonads and Thiobacilli; Pseudomonads are involved in the breakdown of organics, and reduced sulfur compounds are attacked mainly by Thiobacilli. The heterotrophic organisms obtaining carbon and energy from the aromatic and heterocyclic compounds of waste liquors are closely associated with those deriving energy from other processes. Some of the constituents in the effluents can affect the metabolism of some of these microorganisms. The products of reactions carried out by the microorganisms include substances necessary for their growth. Bacteria may act on some compounds preferentially; metabolic intermediates are often used preferentially to the original compounds. Adding certain organic compounds to the liquor feed increased the biochemical oxidation rate by as much as three times. The compounds also often improve effluent quality. Studies indicate that bacteria probably do not play a role in removing liquor components in waste-tip lagoon systems.

*Waste water treatment, *Microorganisms, *Bacteria, *Activated sludge, Organic compounds, Industrial wastes, Oxidation

Carbonization effluents

D105

ANAEROBIC TREATMENT OF DILUTE WASTE WATERS,

Van Der Meer, R. R., Van Brakel, J., and Heertjes, P. M.

Delft University of Technology,
Delft, The Netherlands,
Laboratory of Chemical Engineering.

Delft Progress Report, Vol. 1, No. 5, p 143-149, 1976. 6 fig, 4 tab, 23 ref.

The application of anaerobic digestion to purification of dilute waste water was studied. Five reactors were used: a packed up-flow reactor (PUR) filled with high porosity polymer objects, a PUR filled with 2 to 3 cm gravel, an intermittently stirred up-flow reactor (ISUR), an ISUR with a device to break floating sludge, and an ISUR with sludge recycling. Simple substances such as acetate, glucose, and beet sugar were used to simulate waste water. An anaerobic up-flow reactor can reduce the chemical oxygen demand (COD) of these model waste waters to 10%. Two to 5 kg COD/cu m day is the maximum organic loading, corresponding to 7 to 18 hr retention times. Twenty to 50 days are required for a system to completely adapt to a particular feed. After adaptation, it adjusts easily to changing conditions and recovers rapidly from short disturbances such as a pH drop. There were no significant differences between the behavior of the packed bed and the ISURs.

*Anaerobic digestion, *Waste water treatment, *Sludge treatment, *Recycling, Chemical oxygen demand, Equipment

Stirred up-flow reactor (ISUR)

D106

THE DESERT WAR ON POLLUTION,

Gardner, N.

Water Services, Vol. 80, No. 960, p 87-88, February, 1976.

Rapid industrial and social development is taking place in Middle Eastern countries which had simple agricultural economies only 10 years ago. The greater prosperity and new industries have created a demand for better water treatment facilities. Desalination of water from desert bore-holes and sea water is often done in thermal type plants, due to the abundance of energy. Due to the scarcity of water, recycling of waste water is emphasized. Processes for recycling industrial waste water usually leave a concentrated waste, which will be disposed of at sea or on land following chemical and physical or thermal treatment. Aeration, which requires a minimum of maintenance, is frequently used for sewage. The deep shaft treatment process, in which effluent is circulated between two compartments in a shaft several hundred ft deep, has significant advantages for the Middle East. Attention is also being focused on the disposal of municipal solids. They can either be incinerated, with the ash used for landfill, or can be applied directly to land as compost. Due to the shortage of local water and sewage treatment consultants in the Middle East, there is competition between European, United States, and Japanese consultants. The Middle East has accounted for large increases in exports of British water treatment contracts. However, British export regulations sometimes make it impossible for British companies to bid competitively on the larger contracts.

*Waste water treatment, *Recycling, *Water reuse, Water treatment, Sewage treatment, Waste disposal, Aeration

D107

A STUDY OF ROTATING-DISC TREATMENT UNITS OPERATING AT DIFFERENT TEMPERATURES,

Ellis, K. V., and Banaga, S. E. I.

Technology University,
Loughborough, Great Britain,
Department of Civil Engineering.

Water Pollution Control, Vol. 75, No. 1, p 73-91, 1976. 13 fig, 5 tab, 20 ref.

The optimum mode of operation of a rotating-disc unit (RDU) and the effects of three different temperatures on its efficiency were studied. For a 14 week preliminary period, the specially designed laboratory RDUs were operated to establish the general capabilities of the design, to gain reasonable experience in operating the unit, and to establish an optimum rotational speed for the discs. During the principal investigation, the three RDUs were operated at 11 C, 18 C, and 27 C. Various hydraulic retention periods and liquid levels were investigated. A disc rotation speed of about 4 rev/min produced the best results, and was used throughout the principal investigation. Laboratory scale RDUs were able to remove 97.5% of the biochemical oxygen demand (BOD) loading applied, and operated efficiently at over 20 g BOD/sq m d. BOD removal ability appreciably increases with temperature from 10 C to 20 C and less dramatically from 20 C to 30 C. The rotating discs should optimally be immersed 26% into the reaction vessel liquid. With the discs 26% immersed, 4 rev/min disc speed, and 97 min liquid retention, units operating at all three temperatures tested, produced effluents well within the Royal Commission standard. Effluent recirculation failed to appreciably improve the effluent. The concentration of mixed liquor suspended solids (MLSS) in the reaction vessel was about 23,000 mg/liter. This individual small unit may be between 3 and 7 times as efficient as the activated sludge process and 40 to 60 times as efficient as a conventional biological filter.

*Biological treatment, *Hydraulics, *Laboratory tests, *Biochemical oxygen demand, Temperature, Waste water treatment

*Rotating discs

D108

NEW YORK TAKES ANOTHER GIANT STEP,

Gerber, H. B., and Brinckerhoff, G. G.

Water and Wastes Engineering, Vol. 13, No. 3, p 24-26, 28, 48, March, 1976. 7 fig.

Construction of an upgrading project at New York City's Jamaica Water Pollution Control Plant is nearing completion. The project includes a new sewage pumping station and screenings building; conversion of the primary settling tanks to remove both grit and sludge; converting the grit building to a grit and storage building; a new system to remove grease and scum; two new aeration blowers, and a new aeration system in the aeration tanks; conversion of the gas compressor building to an effluent pumping station; a new system to distribute waste sludge to the sludge thickening tanks; a new sludge thickening tank and extensive modification to two others; a new hypochlorite building; extensive modifications to the sludge digestion tank equipment and the gas collection and storage system; a sludge force main to another water pollution control plant; all new measuring and recording instruments; modifications to the plant drainage system; and major changes to the heating, ventilating, air conditioning, plumbing, and electrical systems. The existing sewage pumping station could not be demolished until the new one was ready to operate, so the new pumping station had to be built between the existing one and the main building, only 8 ft from the latter.

*Treatment facilities, *Sewage treatment, *Waste water treatment, *Aeration, Tanks, Equipment, Sludge treatment, Construction, New York

D109
PURIFICATION OF WASTE WATER BY POLYMER EXCHANGERS
(Jatevesien puhdistaminen polymeerivaihtajilla),

Pulkkinen, E.

Kemia-Kemi, No. 1, p 6-11, January, 1976. 11 fig, 3 tab, 8 ref.

Colloidal hydrophobic particles in water are negatively charged and it is this charge that keeps them dispersed. They can be stabilized by adding an electrolyte, which causes the ion cloud surrounding the particles to shrink; by adding an electrolyte that neutralizes the negative charge; by adding an anionic polyelectrolyte that causes the particles to bunch together; or by destabilizing the pH of the particles so that they lose their charge and coagulate. In treating domestic waste water by the activated sludge process, sludge settlement takes place more rapidly with the addition of cationic polyelectrolytes. Anionic polyelectrolytes are suitable for thickening primary waste water, whereas secondary sludge or the activated sludge is best thickened through the action of cationic polyelectrolytes. The concentration of primary sludge with anionic polyelectrolyte in the vacuum filter process works well; however, the addition of a small amount of anionic polymer (HPAM) followed by cationic polyamines works better for activated sludge. Cationic polymers have proven indispensable in concentrating municipal waste water by the centrifugal process. The cost of electrolytes has remained relatively high in Finland, which is one reason that they are not widely used in that country. Recently, the Oulu University Chemistry Department has been studying water soluble polymers, with the objective of explaining the effects of cationic polymer structures on the precipitation ability of colloids.

*Activated sludge, *Colloids, *Coagulation, *Polymers, *Polyelectrolytes, *Flocculation, *Waste water treatment, Sludge treatment, Cations, Anionss, Municipal wastes, Costs, Chemical precipitation

Finland

D110
INDUSTRIAL EXPERIENCE OF SEWAGE SLUDGE PROCESSING WITH
ZIMPRO INSTALLATIONS IN THE NETHERLANDS,

Koster, E. L. C., van der Graff, J. H. J. M., and ten Wolde,
J. G.

Berichte der Abwassertechnischen Vereinigung e.V., No. 28, p 429-445, 1976. 12 fig, 6 tab, 1 ref.

Industrial experience in processing fresh sewage sludge by the Zimmerman process has been obtained at installations at Apeldoorn and Breda in the Netherlands. The Zimmerman process's general characteristics—insensitivity to toxic components and changes in sludge composition, completely sterilizing fresh sludge by thermal oxidation without chemical conditioning, and excellent sludge dewatering properties—were important in the final choice of the processing system. The sludge at Apeldoorn has a large contribution from paper mills and 45% organic content. The sludge at Breda has a large contribution from the canned food industry and a 73% organic solids content. The systems for dewatering and discharging the filter cake differ; Apeldoorn uses a vacuum filter and a discharge system of conveyor belts and containers, and Breda uses filter presses, chain conveyors, and silos. The high organic solids content in Breda had an unfavorable effect on the thickening results. Due to rotting, buffering of fresh sludge in thickeners adversely affects the thickening results and must be kept to a minimum. Scaling in the heat exchangers may affect the energy balance, but the scaling can be removed by acid washes. The biochemical oxygen demand (BOD), chemical oxygen demand (COD), and Kjeldahl nitrogen at Breda increased after the Zimmerman process plant came into operation. The filter cake from Breda is suitable for use as a soil conditioner, but not a fertilizer, due to the lack of nitrogen.

*Sewage treatment, *Sludge treatment, *Filtration, *Dewatering, Oxidation, Industrial wastes, Nitrogen, Biochemical oxygen demand

*Zimmerman process

D111

ASSESSMENT OF VIRUS REMOVAL BY A MULTI-STAGE ACTIVATED SLUDGE PROCESS,

Safferman, R. S., and Morris, M-E.

United States Environmental Protection Agency,
Cincinnati, Ohio,
National Environmental Research Center.

Water Research, Vol. 10, No. 5, p 413-420, 1976. 3 fig, 6 tab, 22 ref.

The virus removal capacity of a complex multistage biological system combined with appropriate chemical additives and final filtration was studied. The indigenous viral population in the primary effluent and after each stage of treatment were determined. The system was then seeded with phage f2 and sampled again at the same locations. The treatment process effectively reduced the seeded viruses. The highest reduction was in the high-rate activated sludge and denitrification modules, both averaging over 95% virus removal. Virus reduction for the treatment system as a whole was calculated at 99.97%. The indigenous viruses present after primary settling illustrated the wide diversions that can occur in waste waters during a 24 hr period and the necessity of collecting temporally related samples within the treatment system. There was apparently no direct relationship between the quantities of enteroviruses and coliphages present in primary effluent.

*Viruses, *Activated sludge, *Biological treatment, Chemical precipitation, Waste water treatment, Effluents

D112

SLUDGE HEAT TREATMENT: OPERATION AND MANAGEMENT,

Whitehead, C. R., and Smith, E. J.

Water Pollution Control, Vol. 75, No. 1, p 31-39, 1976. 1 fig, 7 tab, 4 ref.

The former Urban District of Havant and Waterlooville, Great Britain, treats sludge by heated digestion followed by heat treatment, with any surplus digested sludge being treated on drying beds. Sludge was treated on drying beds and in lagoons until 1961, when experimental work and cost investigation indicated that heat treatment would be the most economical process. Methane is collected and used as the main boiler fuel for heat treatment. Several modifications have been made to the system since it was commissioned. The plant was designed for treating 145.5 cu m/d of digested sludge at 5% dissolved solids (DS) or less. The filter presses will produce a cake of at least 50% DS in a pressing period of 2 hr or less. Variations in sludge consistency and significant changes in the rate of heat absorption led to the need to chemically clean the heat exchanger. Since March 1971 the plant has been run continuously until conditions indicate that a heat exchanger wash is required. Such conditions include increased boiler pressure, increased differentials across heat transfer surfaces, fall in the acceptable level of dry solids, increased press times, fall-off in press standards, and increase in odor from the plant. Recurrent problems have involved discharge valves, mono pumps, and farm flow units. The liquor treatment facilities at the plant consist of conventionally arranged biological filters. A spray deodorizer system around the plant's perimeter and a fiberglass lid and an ozonator for the thickening holding tank are used to control odor.

*Heat treatment, *Sludge treatment, *Waste water treatment, *Methane, Biological treatment, Treatment facilities

D113

INDUCTIVE CAVITATOR KEEPS FILTER GRATINGS CLEAR OF DEBRIS,

Stengel, R. F.

Design News, Vol. 31, No. 9, p 19, May 10, 1976. 2 fig.

Effluent in process plants sometimes contains solid debris that should not enter sewage lines. Installing a filter grating with suitable mesh width traps the debris, clogging the filter. Periodical shutdowns are usually used to clean the grating. Periodical or continuous mechanical means work poorly with some grating types. A solution involves a main outflow line below the grating carrying clean effluent and a secondary stream directly above the grating flushing off the debris. A mechanical oscillator at the lowest part of the tank acts through the liquid, shaking debris from the grating. The inductive cavitator is purposely run not at resonance, unlike many previous sonic systems. The off-resonance driving frequency permits precisely controlling vibratory energy delivered to the liquid. The direction of the externally polarized motion is adjustable, if needed, to distribute energy more uniformly through the liquid volume.

*Filtration, *Filters, *Waste water treatment, *Effluents, Equipment, Flow

*Filter gratings, Inductive cavitators

D114

EFFLUENT DETENTION PONDS DECHLORINATE WASTEWATER,

Stone, R., Smallwood, H., and Bennett, L.

Ralph Stone and Company, Incorporated,
Engineers,
Los Angeles, California.

Public Works, Vol. 107, No. 5, p 90-91, May, 1976. 1 fig.

The Oak View Sanitary District installed a unique facility for waste water dechlorination at a minimum cost to meet the California and United States requirements for no free chlorine discharge into the Ventura River. In 1975, the optimum dosage of chlorine to the effluent was about 165 lbs per day, producing a residual 2.5 to 3.0 mg/liter at the outlet of the chlorine contact chamber. Two dechlorination ponds with a capacity of about one million gallons each provided an average retention time of over one day at the 1975 flow rate. These ponds have concrete-lined slopes and unlined floors and an average operating depth of 5.5 ft. Longitudinal baffles to improve velocity distribution restrict the flow channel width to 25 ft. The dechlorination ponds reduce 5 day biochemical oxygen demand (BOD) and suspended solids as well as reducing chlorine residuals to less than 0.1 mg/liter. Since the probe of a chlorine analyzer becomes insensitive to chlorine if it is not periodically exposed to a chlorine solution, the required residual monitor samples the chlorine contact chamber effluent and the final effluent alternately.

*Waste water treatment, *Chlorine, *Biochemical oxygen demand, Suspended solids, Analytical techniques, Treatment facilities, California

*Chlorine analyzer, *Dechlorination

D115
DEVELOPMENT OF EDINBURGH'S SEWAGE DISPOSAL SCHEME,

Crockett, A. S., and Dugdale, J.

Proceedings of the Institution of Civil Engineers, Vol. 60, Part 1, p 53-78, February, 1976. 20 fig, 2 tab.

A conditional consent given by the Lothians River Purification Board to continue existing discharges from Edinburgh required an improvement to be completed by May 1976. The existing system involves discharge of crude sewage into the Forth estuary through a number of short outfalls. The new system devised includes interceptor sewers, primary treatment on a site reclaimed from the estuary, and disposal of the effluent through an outfall and of the sludge at sea. Geological conditions in the area are quite varied. Interception will be through storm sewage overflows with storm sewage allowed to continue down the existing sewers. Because many of the routes lie through built-up areas, much of the construction must be done in tunnel. The site for reclamation is ideal; it is well situated with respect to the outfalls, near an industrial area, under shallow water, and angularly shaped to allow for a shorter sea wall. Four large sedimentation tanks will be used for treatment. Four very large storm tanks are also provided in which material can be held for return to sedimentation. Effluent will be discharged through 20 vertical diffuser feed pipes rising from the latter part of the outfall tunnel. It is predicted that the E. coli concentration at emenity beaches under worst conditions will be no greater than 1000/100 ml. Sludge will be discharged at sea by gravity from a moving vessel. The cost of the full scheme is estimated at 26.04 million pounds. Construction of the system is progressing, and a reduced scheme is expected to operate by autumn 1976.

*Waste disposal, *Outfalls, *Sewage disposal, Storm water, Sedimentation, Effluent, Interceptor sewers, Sludge disposal, Construction

D116
INCREASING THE CAPACITY OF SEDIMENTATION TANKS BY MEANS OF SLOPING PLATES,

White, M. J. D., Baskerville, R. C., and Day, M. C.

Water Pollution Control, Vol. 75, No. 1, p 21-30, 1976. 6 fig, 16 ref.

A module of inclined tubes was installed in one of two identical humus tanks at a sewage treatment works serving a population of about 1800. Sewage was pumped intermittently, producing a cyclic flow variation in the tanks. Sloping tubes can increase the capacity of a conventional horizontal flow sedimentation tank by an amount directly proportional to their projected surface area. The temperature of the influent should not be more than 0.2 C higher than that of the bulk liquid, and the module should be washed down once every one or 2 weeks. Sloping tubes appear suitable for uprating humus tanks, but less suitable for primary tanks and probably not suitable for tertiary treatment tanks without use of a flocculant. Installing sloping tubes in an existing tank is expected to be less expensive than building a new tank of the same surface area, but the plastic tubes will probably not last as long as a new tank.

*Flocculation, *Sewage treatment, *Tanks, *Sedimentation, Equipment, Efficiency, Installation

Sloping plates

D117

MONITORING AND AUTOMATIC FILTER CONTROL OF THE DREIS-TIEFENBACK TREATMENT PLANT (BETRIEBSUEBERWACHUNG UND AUTOMATISCHE FILTERSTEUERUNG DER AUFBEREITUNGSANLAGE DREIS-TIEFENBACH),

Roesel, H., and Stein, H.

Wasser und Boden, Vol. 28, No. 4, p 76-79, 1976. 5 fig, 1 ref.

The Dreis-Tiefenbach waterworks and its automatic filter control are described. Raw water obtained from a barrage and from groundwater is first aerated for oxygenation and for the partial removal of carbon dioxide. Suspended matter, iron, and manganese are removed in a first filter stage that uses such chemicals as aluminum sulfate, potassium permanganate, and aqueous lime. Quartz gravel is used for filtration. The water is treated with potassium permanganate, carbon dioxide and lime in a second filter stage composed of Jurassic chalk. In a final step, the water is chlorinated before distribution.

*Treatment facilities, *Water treatment, *Filtration, *Water works, *Control, Filters, Aeration, Chlorination, Oxygenation

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D118

TECHNIQUE ALTERNATIVES FOR A PACKAGE STABILIZATION PLANT,

Li, E. C. C.

Water and Sewage Works, Vol. 123, No. 5, p 60-61, May, 1976. 3 fig, 2 tab, 2 ref.

Deficiency of activated sludge in package contact stabilization was studied. In this process, activated sludge adsorbs small solid particles and absorbs dissolved matter in the presence of oxygen in the contact zone, is separated from the treated sewage in a clarifier, is pumped to the reaeration zone where the bacteria grow and reproduce, and returns to the contact zone. Package plants encountered process problems, mostly concerned with the activated sludge, caused by such factors as a hydraulic overload, a frequent waste shake, insufficient waste nutrients, and unbalanced turbulence. An attempt was made to correct these problems by increasing the activated sludge content and operating as an extended aeration process, but the biochemical oxygen demand (BOD) and total suspended solids (TSS) in the effluent increased significantly. The use of aeration control to build up the activated sludge was also attempted. A third alternative involves acclimating the activated sludge before adding it to the reaeration zone and adding a filter to prevent carry-over of finely divided solids into the effluent.

*Waste water treatment, *Sewage treatment, *Biological treatment, *Activated sludge, *Biochemical oxygen demand, Treatment facilities, Stabilization, Aeration, Suspended solids

*Contact stabilization, *Package plants

D119

SLUICE GATES HELP REGULATE PLANT'S HYDRAULIC FLOWS,

Water and Sewage Works, Vol. 123, No. 5, p 77-79, May, 1976.

A sluice gate arrangement for regulating hydraulic flows at a new Jackson, Mississippi, sewage treatment plant is described. The plant uses an activated sludge treatment process with contact stabilization and is designed so that influent must either be processed or temporarily stored in lagoons when flooding conditions exist. Comminuters and grit chambers in the plant make use of a 16-gate arrangement to control flows. Four 42 by 36-inch sluice gates are arranged around a comminuter pool controlling flows to four additional gates located at the grit chamber influent. Eight other gates are located on the grit chamber. Flow from the grit chambers passes on to the contact stabilization tanks, reaeration tanks, and ultimately to clarifiers. Four 48 by 48-inch gates located in the contact tanks and eight 30-inch diameter gates in the aeration tanks can be modulated to regulate flows in accordance with commands given by a control room operator who has access to flow meter readings. When the plant reaches its hydraulic capacity of 60 million gallons, excess flow is diverted to lagoons via a 60-inch diameter storm water bypass gate. Other gates at the plant include three self-contained gates at the effluent end of the chlorination lagoon and an additional modulating gate at the effluent outfall.

*Sluice gates, *Hydraulic gates, *Hydraulic structures, *Flow control, *Sewage treatment, *Waste water treatment, Engineering structures, Gates, Sewage lagoons, Activated sludge, Sanitary engineering

Contact stabilization

D120

DEWATERING OF SEWAGE SLUDGE VIEWED AS PART OF THE PURIFICATION PROCESS -- PLANNING CRITERIA (KLAERSCHLAMMENTWAESSERUNG ALS TEIL DER GESAMTEN KLAERAUFGABE BETRACHTET -- PLANUNGSKRITERIEN),

Henseler, G.

Wasser, Energie, Luft, Vol. 68, No. 1, p 17-23, 1976. 7 fig, 4 tab, 13 ref.

Different methods for sewage sludge dewatering for subsequent distribution on farmlands or disposal on sanitary landfills are reviewed. To avoid malodorous emissions, only thoroughly digested sludge with a minimal dry matter content of 50% should be distributed on farmlands. Dewatering requires cold chemical conditioning by flocculation and oxidation, or hot conditioning at 200 C under increased pressure, which is also suitable for sludge sterilization. Low-pressure band and drum filters, vacuum filtration, high-pressure filtration and centrifugation are described. Worm centrifuges with solid jackets, operating at accelerations as low as 400 g, are able to separate over 95% of water from the sewage sludge.

*Dewatering, *Sewage sludge, *Fertilizers, *Land use, Odor, Flocculation, Oxidation, Filtration, Filters, Centrifugation, Sludge disposal, Landfills

D121
THE EFFLUENT LAGOONS GREIFSWALD-LADEBOW (DAS ABWASSERTEICHSYSTEM GREIFSWALD-LADEBOW),

Schwarz, S.

Wasserwirtschaft-Wassertechnik, Vol. 26, No. 3, p 94-96, 1976. 6 fig, 4 ref.

The effect of two turboventilators installed in the first member of a lagoon series with a capacity of 8,000 cu m/day and a flowthrough time of 9.3 days was studied by investigation of chemical, biochemical and biomass parameters. The observed rapid equalization of the temperatures of freshly admitted waste water and of lagoon water implies reduced heat losses to the air, and consequently high bacterial activity even during the winter period. Ventilation resulted at best in a negligible rate of activated sludge formation. The increase in the BOD5 level was due only partly to the overloaded ventilated system. Ventilation at the same time intensified the enzymatic degradation of organic substances in contact with sludge-covered surfaces.

*Waste water treatment, *Activated sludge, *Biochemical oxygen demand, *Treatment facilities, *Lagoons, Effluents, Ventilation, Temperature

Turboventilators

D122
POSSIBILITIES AND LIMITS OF EXTENDED WASTE WATER PURIFICATION (MOEGLICHKEITEN UND GRENZEN DER WEITERGEHANDED ABWASSERREINIGUNG),

Poepel, F., and Sekoulov, I.

Institut fuer Siedlungs-Wasserbau und Wassergutewirtschaft,
Stuttgart, Germany.

Umweltschutz-Staedtereinigung, No. 4, p 76-80, 1976. 1 tab, 9 ref.

Possibilities and limitations of the final purification of waste water in biological treatment plant for the protection of recipients and to guarantee an adequate water quality for drinking-water preparation are described. The BOD5 level of the purified waste water can be substantially reduced by the removal of suspended matter, for which process sand filters flushed with hydrogen peroxide-treated water, and microstrainers with 20-25 micron-mesh are available. Nitrification can be intensified by the use of porous percolation bodies and sand filtration, using oxygenated water. The subsequent biological denitrification in sand filters is performed without oxygen, and the oxygen liberated from the nitrates is used for the oxidation of other organic substances. Phosphorus can be eliminated from waste waters by chemical precipitation with trivalent metal salts or lime, or by increasing the pH value by means of flue gases, sodium hydroxide, or a biological process using algae which liberate oxygen from carbon dioxide. It is possible to reduce the phosphorus level to below one mg/liter.

*Waste water treatment, *Biological treatment, *Biochemical oxygen demand, *Nitrification, *Denitrification, Oxidation, Chemical precipitation, Phosphorus, Suspension, Filters, Sands, Percolation, Organic matter, Hydrogen ion concentration

Nitrification/denitrification

D123

THE CHEMISTRY OF OZONE IN THE TREATMENT OF WATER,

Peleg, M.

Hebrew University of Jerusalem,
Israel,
School of Applied Science and Technology.

Water Research, Vol. 10, No. 5, p 361-365, 1976. 1 tab, 50 ref.

A review is presented of the chemistry of ozone in water and the potential disinfection efficiencies of ozone and its probable dissociation species in water. Ozone, an unstable gas that decomposes slowly in the gaseous phase to ordinary oxygen, will decompose at a greatly accelerated rate under thermal conditions. Knowledge of the mechanism and kinetics of the dissociation of ozone in water is uncertain. On the basis of several studies reviewed, the possible species to be found in aqueous ozone solution are O_3, OH, HO_2, O^-, O_3^-, and possibly the free oxygen atom if ozone decomposes before reacting with the water. Ozone has one of the highest oxidation potentials known, 2.07 V in acidic solutions and 1.24 V in basic solutions. Similar reactions of the hydroxyl radical and ozone have been noted. Both produce similar effects in the reduction of the organic carbon content of waste water effluents. Additionally, the ozonization of phenol in aqueous solution and the oxidation of phenol by OH both produce catechol and o-quinone as intermediate products. Investigations suggest that the dissociation products may be more powerful oxidation agents than ozone itself. Further experimental work is being performed in order to make more definitive statements about germicidal properties of ozone and its dissociation species in water. More work is needed on the effect of pH changes and increased catalytic decomposition of ozone on its disinfection ability.

*Ozone, *Water treatment, *Waste water treatment, *Organic compounds, *Kinetics, Analytical techniques, Phenols, Water chemistry

Hydroxyl radicals

D124

OZONE PROVIDES ALTERNATIVE FOR SECONDARY EFFLUENT DISINFECTION PART 2,

Nebel, C., Gottschling, R. D., Unangst, P. C., O'Neill, H. J., and Zintel, G. V.

Welsbach Ozone Systems Corporation,
Philadelphia, Pennsylvania.

Water and Sewage Works, Vol. 123, No. 5, p 82-85, May, 1976. 8 fig, 3 tab, 41 ref.

As the second part of a continuing article, this paper describes new, economically feasible methods using ozone for the disinfection of secondary effluents. Contaminant removal may be achieved by a two-step process utilizing flotation. Suspended solids not captured by the plant secondary clarifier may be removed from the ozone contact chamber in this process. Additionally, ozone in small dosages removes substantial amounts of colored material. Reduction of COD in secondary effluent with ozone oxidation and physical removal by frothing was seen to vary, depending upon the initial COD level of the effluent. While refractory materials are biodegradable by ozonization, BOD values are mildly increased during ozonation of industrial municipal effluents. Studies on the oxidation of nitrogenous materials by ozone have been inconclusive, and ozonolysis cannot be considered a nitrification process. Phenol reduction has been demonstrated to take place rapidly at relatively low dosages of ozone. Additionally, pH is generally shifted following ozonation of secondary effluent. The formation of weak carboxylic acids from hydrocarbons tends to reduce pH, while CO_2 produced in the activated sludge process being removed by sweeping large volumes of air or oxygen through the ozone contact chamber tends to increase pH.

*Sewage effluents, *Waste water treatment, *Disinfection, *Ozone, Phenols, Suspended solids, Chemical oxygen demand, Biochemical oxygen demand, Nitrogen, Color, Odor, Oxidation

D125
HYDROGEN PEROXIDE SOLVES SLUDGE ODOR PROBLEM,

Miller, R. G.

Water and Sewage Works, Vol. 123, No. 5, p 74-76, May, 1976. 1 fig.

An extreme problem with hydrogen sulfide odor from sludge dewatering at a waste treatment plant was solved using hydrogen peroxide treatment. The activated sludge plant serves Appleton, Wisconsin, treating both residential and industrial waste. A classical pattern of primary and secondary treatment is used. The filter room odor problem had existed ever since the secondary treatment facility began operation. The dewatered sludge disposed of on land also emitted a sulfide odor. Hydrogen peroxide, which controls hydrogen sulfide odors by breaking down hydrogen sulfide into elemental sulfur and water, was tested for effectiveness. The hydrogen peroxide was injected into a main between the storage tanks and the vacuum filters, to remove the sulfide producing slimes that populated the mains. Injection at 50 ppm resulted in no sulfides or odor in the sludge and no hydrogen sulfide in the atmosphere. The sulfide odor in the filter room also disappeared, and the hydrogen peroxide was easy to store and inject. This method of odor control was instituted immediately after it was proved effective.

*Waste water treatment, *Activated sludge, *Treatment facilities, *Sludge treatment, *Dewatering, Odor, Hydrogen sulfide, Industrial wastes, Domestic wastes

Hydrogen peroxide

D126
WHAT TO DO WITH SEWAGE SLUDGE,

Mosaic, Vol. 7, No. 3, p 20-28, May-June, 1976. 1 fig.

Higher degrees of purification of waste water are producing larger amounts of sludge, at the same time that it is becoming more difficult to dispose of. Application to land is considered more practical than burning or disposal at sea. Problems with application to land include the heavy metal content of the sludge, odor, and objections from local residents. Most existing sludge disposal options seem to have serious drawbacks. Research is underway on the economic and health problems of land disposal. One system being studied involves injection of sludge under the soil surface. Potential problems with the method include nitrate pollution of groundwater, contamination of crops with heavy metals, and infection of soil and groundwater with microorganisms. The extent of these problems varies with sludge, soil, and moisture conditions. Microorganisms pose the most serious problem. Irradiation of sludge is being studied as a means of inactivating pathogenic agents.

*Sewage sludge, *Sewage disposal, *Waste water treatment, *Land use, Odor, Heavy metals, Groundwater, Water pollution sources, Microorganisms, Irradiation

Land application

D127
FOUR-MODE TREATMENT PLANT WILL GENERATE SODIUM HYPOCHLORITE ONSITE,

The American City and County, Vol. 91, No. 5, p 22, May, 1976.

Seawater will be used for generating sodium hypochlorite for use as a disinfectant in a waste water treatment plant being constructed in New Haven, Connecticut. Volume and strength of the waste water and Connecticut State requirements dictated design of a flexible aeration system. The aeration process includes four modes: conventional activated sludge to treat low-strength domestic wastes, a complete-mix process to protect against shock loads, step aeration for better oxygen utilization which periodically may be required, and contact stabilization because land for later staged expansion is unavailable. Adjustable outlet weirs, either automatically or manually operated, will control the water levels of the aeration basins to provide the required extent of oxygen transfer. Warm, screened seawater, previously used for condenser cooling, will be obtained from an electric generating station outfall near the treatment plant. After degritting, gravity thickeners and centrifuges will thicken the primary sludge, and primary and thickened waste activated sludge will be mixed. A reactor will oxidize volatile sludge solids; insoluble volatile matter in the sludge is reduced by 30%, and the oxidized sludge is then thickened. The dewatered sludge will be disposed of in a multiple hearth incinerator. The facility, which is scheduled for completion in 1979, will be able to handle 100 mgd peak flow and will reduce biochemical oxygen demand (BOD) and suspended solids by 90%.

*Waste water treatment, *Activated sludge, *Biochemical oxygen demand, *Treatment facilities, *Sodium compounds, Sea water, Disinfection, Aeration, Suspended solids, Sludge disposal, Dewatering, Incineration

Sodium hypochlorite

D128
HOW TO DESIGN AERATED LAGOON SYSTEMS TO MEET 1977 EFFLUENT STANDARDS SYSTEM DESIGN,

Rich, L. G., and White, S. C.

Clemson University,
Clemson, South Carolina,
Environmental Systems Engineering.

Water and Sewage Works, Vol. 123, No. 5, p 88-89, May, 1976. 2 fig, 4 ref.

The total biochemical oxygen demand (BOD) in aerated lagoon effluent is the soluble BOD in the effluent plus 0.54 times the volatile suspended solids in the effluent. Assuming no algae in the effluent, about 20 mg/liter suspended solids is expected; therefore, the soluble BOD should be 20 mg/liter or less and probably 10 mg/liter or less to allow a margin for error. A partially suspended lagoon following a completely suspended lagoon requires less total volume than a single lagoon does to achieve the same soluble effluent BOD concentration, and an equation makes it possible to calculate the BOD in the first lagoon when the combined area is a minimum. Once this value has been computed, the required hydraulic retention times can be estimated for the lagoons. Total retention times were determined as a function of the soluble BOD in the effluent from the first lagoon for waste waters with different kinetic coefficients. The minimum hydraulic retention time in the first cell to prevent washout of all biomass solids can be calculated, and is equal to .60 d for most domestic waste waters. The minimum retention times for both solids removal and soluble BOD should control the system design. The hydraulic retention time in the partially suspended cell should not exceed 3 days, to prevent growth of algae. The possibility of sludge accumulation in this cell and its disposal should be considered in designing the system.

*Waste water treatment, *Biochemical oxygen demand, *Treatment facilities, *Aerated lagoons, *Design, Effluents, Suspended solids, Suspension

D129

FACTORS IN THE PURIFICATION OF FLOWING SEWAGE AND ACTIVATED SLUDGE PROCESS - PART 2,

Pillai, S. C., Srinath, E. G., Viswanathan, C. V., Bai, B. M., and Viswanath, G. K.

Indian Institute of Science,
Bangalore, India,
Department of Biochemistry.

Water and Waste Treatment, Vol. 18, No. 10, p 42, 44, October, 1975. 1 fig, 42 ref.

Factors affecting the purification of flowing sewage discharged from Bangalore into two main natural channels on the outskirts of the city were compared with those affecting activated sludge processes. A common factor to both processes was the development of similar protozoa, particularly the Epistylis and Carchesium species of Vorticellid protozoa. The time necessary for the purification of sewage flowing in the channels ranged from about 4-6 hr which is comparable to that required for sewage purification via the activated sludge process. When samples of the sewage were agitated by a continuous air current for 24 hr and the supernatant liquids examined at hourly intervals during this period, there was no appreciable purification. However, when the Vorticellid protozoan Epistylis was grown on a glass tube which was used for aeration of the sewage, the supernatant liquid showed a degree of purification comparable to that caused by an activated sludge in a parallel set of experiments. The influence of the protozoa on sewage purification was further confirmed by the application of a fluidization technique.

*Sewage treatment, *Protozoa, *Aerobic treatment, *Activated sludge, *Municipal wastes, Waste treatment, Treatment, Biological treatment, Microorganisms, Evaluation

Epistylis, Carchesium, Vorticellid protozoa

D130

WHAT'S NEW IN OZONATION, OXYGENATION, REVERSE OSMOSIS AND ULTRAFILTRATION,

Modern Power and Engineering, Vol. 70, No. 4, p 44, April, 1976.

Ozonation techniques for both industrial and municipal waste treatment have increased in recent years and wider applications of ozone to sewage treatment plant effluents have been developed. Since ozone treatment removes contaminants without producing known toxic materials and simultaneously increases the dissolved oxygen levels of the treated waters, emphasis on recycling and reuse of process waters has encouraged renewed interest in the study of ozonation processes. The performance of ozone equipment has improved significantly and costs of producing ozone have been greatly reduced. One United States ozone manufacturer even promises ozone disinfection of water at the same prices as chlorination. Other growing technologies for treating municipal and combined municipal-industrial waste waters are detailed. These include oxygenation, reverse osmosis, and ultrafiltration.

*Ozone, *Reverse osmosis, *Waste water treatment, *Sewage treatment, *Recycling, Sewage treatment effluents, Industrial wastes, Oxygenation

Ultrafiltration

D131

EXPERIMENTS ON RAPID SAND FILTRATION OF BIOLOGICAL SEWAGE TREATMENT-PLANT EFFLUENTS (UNTERSUCHUNGEN UEBER DAS VERHALTEN VON SCHNELL-SANDFILTERN BEI DER FILTRATION EINES BIOLOGISCH GEREINIGTEN KLAERANLAGENABLAUFS),

Hanisch, B., Mayer, V., and Zacher, B.

Wasserwirtschaft, Vol. 66, No. 5, p 144-147, 1976. 5 fig, 4 tab, 3 ref.

Part of the residual biochemical oxygen demand (BOD) in the effluent of biological sewage treatment plants is produced by small floc particles, which are not retained in the final sedimentation tanks. According to experiences in Great Britain, rapid filtration in sand filters can effectively remove these suspended solids. Downflow filters of the kind used for water treatment were used earlier; more recently, upflow filters have also been used. Some results of experiments with filters at The Institut fuer Siedlungswasserbau und Wassergutewirtschaft in Stuttgart-Busnau are reported. These experiments are directed toward correlating the most important parameters of the process. Activated sludge plant effluent, treated in pilot rapid sand filters of both types, is less highly nitrified than was reported for the plants in Britain.

*Waste water treatment, *Sewage treatment, *Treatment facilities, *Filtration, *Sands, Biological treatment, Filters, Biochemical oxygen demand, Pilot plants, Activated sludge

Upflow filters

D132

USE OF THE EARTH'S CRUST FOR TREATMENT OR STORAGE OF SEWAGE EFFLUENT AND OTHER WASTE FLUIDS,

Bouwer, H.

United States Department of Agriculture,
Phoenix, Arizona,
United States Water Conservation Laboratory.

CRC Critical Reviews in Environmental Control, Vol. 6, No. 2, p 111-130, March, 1976. 1 fig, 2 tab, 97 ref.

Land application or underground storage of liquid wastes may be most feasible in a number of situations. Surface application usually is restricted to wastes with mostly organic pollutants. Low-rate systems involve using secondary or equivalent treated effluent to irrigate crops. The amount of nitrogen applied to the soil by sewage sludge is not much more than the crop can remove, but the system must stimulate denitrification for animal waste slurries. Damaging effects of metals can be minimized by lime addition and by growing relatively insensitive crops. Boron is adsorbed by components in some soils. Due to the amount of land needed, low-rate systems are generally used only for small capacity. Overland flow systems, in which waste water flows over sloping fields, can significantly improve quality if the loading rates are relatively low. High rate systems require less land, but the renovated water is usually intercepted to prevent spreading into the aquifer. It can be intercepted by choosing a location where it drains naturally into surface water, or by drains or wells. The water table should not rise high enough below the infiltration area to restrict infiltration. Infiltration and drying periods are generally alternated. Because land treatment is so dependent on local conditions, use of a pilot system for at least one year is desirable. Land treatment costs depend on the cost of the land needed, its distance from the treatment plant, and the cost of wells or drains to collect the renovated water.

*Waste water treatment, *Underground storage, *Waste storage, *Sewage effluents

D133

OPTIMIZING CENTRIFUGE DECANTATION FOR SLUDGE THICKENING (OPTIMISATION DES DECANTEUSES CENTRIFUGES POUR LA CONCENTRATION DES BOUS),

Kallstrom, L.

Alfa-Laval AB,
Tumba, Sweden.

Techniques et Sciences Municipales -- L'Eau, No. 3, p 141-143, March, 1976. 4 fig.

Optimizing a decantation centrifugation installation consists in establishing an equilibrium between yield and economy, and achieving maximum capacity, sludge dryness, and clarity of effluent with minimum energy and chemical expenditure. Adjustment of the installation involves a number of parameters such as rotor and conveyer speeds, and volume of liquid in the rotor. Rate and dosage of the flocculant are then adjusted together by one of two methods or a combination of both; with the first, a feeding rate is chosen significantly lower than the theoretical maximum, thereby increasing transit time and the quantity of fine particles on the rotor. With the second method, more flocculant is used to gather the fine particles into larger flocs which will be deposited more quickly in the force field of the centrifuge. A combination of both is frequently chosen in view of economic considerations.

*Treatment facilities, *Centrifugation, *Sludge treatment, *Industrial wastes, *Sludge, Flocculation, Effluents, Optimization, On-site tests

Centrifuge decantation

D134

REGINA TERTIARY TREATMENT PLANT STUDY AND DESIGN,

Stewart, M. J., and Lewis, D. H.

Water and Pollution Control, Vol. 114, No. 5, p 34, 36-40, May, 1976. 13 fig. 4 tab.

Test results showed that turbidity and phosphates decrease as alum dosage increases, but treatment effectiveness decreases rapidly for alum dosages beyond 150 to 200 mg/liter. It may be possible to achieved higher process efficiencies in summer, but the difference is not always pronounced. The only breakdown in process effectiveness found for lime treatment was with respect to turbidity. The greatest turbidity and phosphorus removals occurred during warm weather. The relative effectiveness of pilot plant operation with and without the settling tube module was compared. Although variability in influent characteristics caused a few aberrant results, the settling tube module was more effective than the conventional clarifier design. This research concentrated on clarification capacity, but it is equally important that the allowable solids loading rate on the bottom of the clarifier not be exceeded. The first stage of a possible future complete treatment plant was built, containing both lime and alum addition facilities operating on a split stream mode to produce a neutralized plant effluent prior to discharge. The plant can treat 20 Imgd from the stabilization ponds. Lime is delivered and stored in pebbled form; alum is transported in liquid form. The chemical clarifiers are interchangeable for either lime or alum feed. One storage basin for lime sludge and two for alum sludge are provided. Clarifier influents and effluents and the combined effluent mixing chamber are automatically sampled.

*Waste water treatment, *Treatment facilities, *Turbidity, *Phosphates, *Nutrient removal, Lime, Efficiencies, Tertiary treatment

*Alum

D135
BUFFERING AIDS DIGESTION OF WASTE,

Chemical Week, Vol. 118, No. 23, p 51, June 9, 1976. 1 fig.

Municipal waste treatment plants work better when buffered with sodium bicarbonate. Sodium bicarbonate use enabled the 37-yr old Hightstown plant, which was once slated for replacement because it could not meet Environmental Protection Agency standards, to operate well within EPA limits. Septic tank users have also reported that sodium bicarbonate additions increased tank life. Some municipal waste treatment plants use sodium bicarbonate on a spot basis to improve alkalinity. It was considered the 'best alkaline chemical' to adjust pH without danger of overdosage. Sodium bicarbonate also reduces biochemical oxygen demand (BOD), sulfide odors, corrosion, and sludge-handling costs; increases solids settling, toxic-pollutant removal, and methane production; and controls nitrification. Rejuvenating the one million-gal/day trickling-filter, biological waste treatment plant in Highstown was the first major project using sodium bicarbonate. Adding sodium bicarbonate to the waste influent and digester produced a return of bacterial activity to the trickling filter and reduced BOD from 36 to 7. Sodium bicarbonate can also significantly reduce sludge volume. Sodium bicarbonate costs more per ton than other waste treatment chemicals, but usually only half the volume of sodium bicarbonate is needed. Sodium bicarbonate is also easier and less hazardous to handle than many chemicals. Although some large plants use sodium bicarbonate for functions such as neutralization and methane production, most users are expected to be small plants where sophisticated equipment is unaffordable.

*Waste water treatment, *Biological treatment, *Biochemical oxygen demand, *Treatment facilities, *Sodium compounds, Bicarbonates, Digestion, Hydrogen ion concentration, Trickling filters

*Sodium bicarbonate, Buffering

D136
WASTEWATER RENOVATION AND REUSE: VIRUS REMOVAL BY SOIL FILTRATION,

Gilbert, R. G., Rice, R. C., Bouwer, H., Gerba, C. P., and
Wallis, C.

United States Department of Agriculture,
Phoenix, Arizona,
Agricultural Research Service.

Science, Vol. 192, No. 4243, p 1004-1005, June 4, 1976. 1 tab, 10 ref.

Renovated water and secondary sewage effluent from four wells at the Flushing Meadows Wastewater Renovation Project, a land disposal project near Phoenix, Arizona, operating since 1967, were sampled about every 2 months in 1974 during flooding periods. The samples were assayed for viruses by bottle culture and the overlay method, using primary kidney cells from immature baboons. The number of viruses detected in the sewage effluents averaged 2118 per 100 liters with a minimum of 158 per 100 liters and a maximum of 7475 per 100 liters. Seven types of viruses were identified, whose occurrence varied seasonally. No viruses were detected in renovated water samples. Apparently human viral pathogens do not move through soil into the groundwater, but are absorbed and degraded by the soil, their numbers being reduced by a factor of at least 10,000.

*Waste water treatment, *Sewage treatment, *Treatment facilities, *Filtration, *Sewage effluents, *Reclaimed water, Groundwater, Viruses

D137

GENERAL CONSIDERATIONS IN WASTEWATER DISINFECTION,

Tonelli, F. A.

Water and Pollution Control, Vol. 114, No. 5, p 23-24, 28, 30, 46-47, May, 1976. 1 fig, 9 tab.

The objective of waste water disinfection is to destroy pathogens before discharging the waste water. Because of the varied resistance of microorganisms to any disinfectant, more than one organism should be used to assess efficiency. Total coliforms or fecal coliforms are usually used. Chemical conditions in the waste water determine the chemical reactions undergone by added chlorine; the effectiveness as a disinfectant varies for different chlorine compounds. Efficiency of disinfection can be seriously impaired at lowered temperatures. Contact time and residual are equally important in determining coliform kill. Thorough initial mixing of concentrated chlorine solution and bulk waste water is necessary for optimum disinfection. A contact chamber with highly developed plug flow characteristics is desirable, so that detention time can be known with some certainty and back mixing can be avoided as much as possible. Process control for chlorination involves maintaining a specified residual at the end of the chlorine contact chamber detention period; methods include manually setting the chlorine addition rate, flow-paced chlorine application, and compound loop control, in order of increasing complexity. Reaction with sulfur dioxide is currently the best developed dechlorination process, but excess sulfur dioxide can increase the oxygen demand of the effluent and depress the pH of the waste water.

*Waste water treatment, *Disinfection, *Chlorination, *Gamma rays, *Pathogenic bacteria, Coliforms, Aquatic microorganisms, Resistance

*Gamma irradiation

D138

UK WORK ON THE USE OF OXYGEN IN THE TREATMENT OF WASTE WATER, ASSOCIATED WITH THE CCMS ADVANCED WASTE WATER TREATMENT PROJECT,

Banks, N.

Department of the Environment,
United Kingdom,
Directorate General Water Engineering.

Water Pollution Control, Vol. 75, No. 2, p 214-220, 1976. 8 tab, 3 ref.

Pilot plant studies dealing with the use of oxygen activated sludge treatment of waste water are reported for a number of sewage treatment facilities throughout the United Kingdom. Oxygen plants appear to be capable of carbonaceous removal at rates higher than those of air plants of comparable size, thus offering land use and cost advantages. Oxygen plants also appear to produce reduced amounts of surplus sludge, and oxygen-produced sludge possesses better settling characteristics than does air-produced sludge. Nitrification is inhibited in enclosed oxygen reactors; however, the resultant effluents can be successfully nitrified in a second stage using air.

*Activated sludge, *Oxygen, *Oxidation, *Sewage treatment, Pilot plants, On-site investigations, Biological treatment, Treatment facilities, Sludge, Nitrification, Treatment, Evaluation, Performance

United Kingdom, Settling characteristics

D139

APPLICATION OF ACTIVATED SLUDGE - DESIGN AND OPERATION,

Bentley, T. L., and Kincannon, D. F.

Water and Sewage Works, Reference number, p R10-R-13, April 30, 1976. 9 fig, 1 tab, 14 ref.

Parameters affecting the operation and performance of laboratory-scale biological towers (trickling filters) were investigated and compared with those commonly used to describe activated sludge processes. Sucrose was used as the carbon source and growth-limiting nutrient for a prepared synthetic waste used in the investigation. The parameters food to microorganism ratio and mean cell residence time which are used for designing activated sludge systems were also found suitable for describing the operation of trickling filters. A comparison of both treatment processes with the same loading parameters resulted in similar treatment efficiencies being obtained. Treatment efficiencies of 95% were obtained in each case for food to microorganism ratios of 0.5. Variation in the percent of chemical oxygen demand removal as a function of mean cell residence time for the experimental trickling towers was also similar to curves obtained for activated sludge systems.

*Trickling filters, *Biological treatment, *Aerobic treatment, *Activated sludge, *Biodegradation, Treatment, Equipment, Chemical oxygen demand, Microorganisms, Evaluation, Performance

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D140

DISPOSAL OF SEWAGE FROM COASTAL TOWNS: THE CASE FOR SEA OUTFALLS,

Calvert, J. T.

John Taylor and Sons,
London, England.

Water Pollution Control, Vol. 75, No. 2, p 153-161, 1976. 6 ref.

A case is made for the disposal of sewage from coastal towns via sea outfalls. The case for direct sewage discharge is based on observations of natural purification. When sewage is diluted 100 times with clean seawater, it is indistinguishable from fully treated secondary effluent in terms of bacteriological properties and is superior in quality in terms of suspended solids and biochemical oxygen demand. Subsequent to the dilution, the natural chemical and biological processes of purification occur such that no change in the character and composition of the sea can be detected. Other reasons for favoring direct discharge involve land use requirements for treatment facilities and the costs involved. Direct sewage discharge to the sea also eliminates sludge treatment problems. Exceptions to the above approach which might favor some form of treatment include cases where toxic materials are being discharged, problems involving visible solids, and coastal areas where currents are unfavorable.

*Sewage effluents, *Sewage disposal, *Sewage, *Outlets, *Oceans, Biological properties, Biochemical oxygen demand, Chemical properties

D141
BIOLOGICAL TREATMENT PROCESS IN COLD CLIMATES,

Boyle, J. D.

Water and Sewage Works, Reference number, p R-28, R-30, R-32-R-34, R-37-R-38, R-43-R-44, R-46, R-48, R-50, April 30, 1976. 16 fig, 2 tab, 9 ref.

The effects of cold climates on three aerobic biological treatment processes are examined. The treatment processes considered are: extended aeration and conventional activated sludge systems utilizing air as an oxygen source, oxygen-activated sludge systems (covered and uncovered), and activated biological filtration systems (activated sludge and trickling filter combinations). Temperature-sensitive parameters discussed include: effluent biochemical oxygen demand, solids production, aeration requirements, horsepower requirements, and heat loss. Housing the biota within a process that is able to resist the adverse effects of low temperature on the processes' kinetics can significantly improve the cold weather performance of biological treatment systems.

*Biological treatment, *Aeration, *Activated sludge, *Trickling filters, *Temperature, *Kinetics, Waste treatment, Equipment, Treatment facilities, Performance, Biochemical oxygen demand, Heat transfer, Cold regions, Climates

D142
VERTICAL STATIC TUBE AERATORS: EVALUATING THEIR PERFORMANCE,

Stewart, M. J., and Lidkea, T. R.

Associated Engineering Services, Limited,
Vancouver, British Columbia.

Water and Sewage Works, Reference number, p R80-R84, April 30, 1976. 5 fig, 2 tab, 10 ref.

A procedure for finding the oxygen transfer rate of vertical static tube aerators based on the oxygen concentration versus elapsed time of aeration values obtained during a given test run is described. The procedure consists of the following steps: an evaluation of the oxygen saturation concentration which has been corrected for site barometric pressure, mid-depth, water pressure, and water vapor pressure; calculation of the oxygen transfer coefficient by plotting the difference between the oxygen saturation concentration and the oxygen concentration in a water sample collected at a given time versus the time on semilog paper; correction of the oxygen transfer coefficient to 20 C; calculation of the true (mid-depth) oxygen transfer rate under standard conditions using the oxygen transfer coefficient at 20 C; and calculation of the transfer rate at the waste water treatment plant site under operating conditions.

*Aeration, *Oxygen, *Transfer, *Rates, Waste treatment, Equipment, Evaluation, Performance, Testing procedures

D143

THE DISPOSAL OF SEWAGE FROM COASTAL TOWNS: THE CASE FOR TREATMENT,

Whitaker, E. C.

Water Pollution Control, Vol. 75, No. 2, p 146-152, 1976. 3 fig.

Factors leading to the decision to install an inland sewage treatment plant at a British coastal town are reviewed. Prior to the treatment plant installation, direct outfall discharge to the sea was observed up to 600 m offshore, and sewage was often observed on high water marks. More than 10,000 kg of litter was removed daily over a 3-kilometer stretch of the coastal beach area. Factors other than pollution of the beaches which contributed to a decision to install an inland treatment plant included: the potential health hazard associated with direct sewage discharge, a rapid increase in housing development with no drainage except cesspools, and flooding as a result of overloaded sewers.

*Oceans, *Sewage treatment, *Sewage effluents, *Sewage disposal, *Sewage, *Beaches, Decision making, Treatment facilities, Public health

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D144

DIFFUSED AIR IN DEEP TANK AERATION,

Schmit, F. L., Thayer, P. M., and Redmon, D. T.

Water Pollution Control Corporation,
Milwaukee, Wisconsin.

Water and Sewage Works, Reference number, p R-86-88, R-90, R-92-R-93, April 30, 1976. 9 fig, 3 tab, 16 ref.

Factors affecting oxygen transfer efficiencies and power requirements of deep tank aeration systems were investigated using a steel tank 34 ft in. wide by 6 ft long by 24 ft deep. Temporary baffles were used to permit the evaluation of two tank widths. For a given oxygen transfer capability, a tank width of 34 ft 4 in was more efficient than a tank width of 19 ft 3 in with the same water depths and submergences. Increased air rates showed an increase in percent oxygen absorption and transfer capability of the diffusers for all tank geometries, depths, and air rates tested at a fixed water depth and submergence. Adiabatic power requirements of transferring a given amount of oxygen were reduced as tank depths increased, regardless of the tank width. An extrapolation of the data obtained over tank depths of 13-23 ft revealed that advantages of deep tank construction apply to depths significantly greater than 23 ft. The extrapolation also indicated that at some depth beyond 23 ft narrower tanks may require less power for a given oxygen transfer.

*Aeration, *Efficiencies, *Oxygen, *Oxygenation, Waste treatment, Equipment, Evaluation, Performance, Waste water treatment, Tanks

Oxygen transfer, Tank geometry, Aeration tanks

D145

IMPORTANT CONSIDERATIONS IN DESIGNING ACTIVATED SLUDGE PROCESSES,

Walker, J. D.

Peabody Welles Incorporated,
Roscoe, Illinois,
Research and Development Division.

Water and Sewage Works, Reference number, p R-54, R-55-R-58, R-60-R-62, April 30, 1976. 5 fig, 1 tab, 1 ref.

Design considerations for air-operated activated sludge processes are discussed. Topics covered include: reaeration, rapid blending of the activated seed sludge with the substrate, air diffuser spacing and placement, clumping tendencies in activated sludge floc, rotary positive blowers, and centrifugal blowers (single stage and multistage). A modification to plug flow activated sludge systems known as complete mixing offers the advantage of blending out high strength, highly soluble biochemical oxygen demand-chemical oxygen demand within the reactor; however, the return seed sludge often requires substantial reaeration to avoid a sludge bulking problem and consequent solids loss to the effluent. The extent of the reaeration should be substantial, for example, at least one-fourth to one-fifth of the detention period, even in plants with high space loadings. Contact stabilization and step feed (both with substantial return activated sludge reaeration) are examples of the application of meaningful reaeration.

*Activated sludge, *Waste treatment, *Reaeration, Biological treatment, Equipment, Performance, Biochemical oxygen demand, Chemical oxygen demand, Mixing

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D146

SMALL SEWAGE WORKS THAT FUNCTION SATISFACTORILY,

Banks, D. H.

Southern Water Authority,
East Sussex, Great Britain,
East Sussex Water and Drainage Division.

Water Pollution Control, Vol. 75, No. 2, p 162-175, 1976. 14 ref.

The status of small rural sewage works throughout England and Wales is reviewed along with options for future design. Over 80% of the more than 5000 sewage treatment plants in England and Wales are administered by rural district councils, indicating the number of smaller sewage treatment plants that have been inherited by 10 newly established water authorities. No radical policy of treatment centralization is expected in view of potential problems associated with constraints in the shape of costly outfall sewers, the possible need for pumping, and the questionable desirability of concentrating effluent discharges into one receiving watercourse. Options available for future sewage works design and construction include: sewage works designed for construction in stages, the design and construction of works with capacities for an ultimate population, and the design of works capable of further expansion. The construction of sewage works which have a life of 30 years or more is considered to be undesirable due to the rate of technological development and change in the sewage treatment field.

*Sewage treatment, *Rural areas, *Treatment facilities, *Administration, *Project planning, *Scheduling, Decision making, Economics

Great Britain

D147

THAMES WATER OPENS STANFORD RIVERS SEWAGE TREATMENT WORKS,

Water Services, Vol. 80, No. 962, p 248, April, 1976.

The opening of the Stanford Rivers Sewage Treatment Works by the Thames Water Authority is described. The new works serve a population of about 12,000 and have a daily inflow of 2500 cu m/day. The sewage treatment works were built in two stages. The first stage involved the provision of a central collection point for sludge treatment and pressing from outlying works and included the construction of sludge holding tanks, mixing tanks, a pumping station, and press house. The second stage called for the rebuilding of treatment facilities to increase capacity and improve the effluent standard and involved the installation of new inlet works, sedimentation tanks, effluent lagoons, a screw pumping house, and ancillary facilities.

*Treatment facilities, *Sewage treatment, *Municipal wastes, Waste water treatment, Treatment, Equipment, Sludge treatment, Sedimentation, Sewage lagoons, Lagoons

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D148

VIRUS REMOVAL IN AN ACTIVATED SLUDGE PLANT,

Naparstek, J. D., Kawata, K., Olivieri, V. P., and
Sherman, V. R.

Community Development,
Hamilton County, Tennessee.

Water and Sewage Works, Reference number, p R-16, R-20, April 30, 1976. 1 fig, 2 tab, 3 ref.

Virus removal studies at a step aeration activated sludge plant in Maryland City, Maryland were conducted. The plant has a design capacity of 750,000 gallons/day and treats primarily domestic waste from residences along with some commercial waste. An f2 model virus was used to seed the influent of the plant, with the resulting seed virus concentration being 1 million plaque forming units/ml as compared with a background virus concentration of between 100 and 10,000 plaque forming units. The average cumulative virus removal throughout the plant was 80.5%. The most significant virus removals occurred in the plant's chlorine contact basin and averaged 72.0%. Virus reductions in the preliminary units, the primary basin, the aeration tank and secondary basin, and sand filters used throughout the process averaged 7.5, 46.8, 11.1, and 22.2%, respectively.

*Activated sludge, *Viruses, *Municipal wastes, *Domestic wastes, *Waste treatment, Treatment facilities, Evaluation, Performance, Microorganisms, Efficiencies, Wastes, Treatment, Sludge, Chlorination, Chlorine

f2 virus, Virus removal

D149

TREATMENT OF SYNTHETIC URINOUS WASTEWATER USING COMBINED REVERSE OSMOSIS, IMMOBILIZED UREASE, AND ION EXCHANGE SYSTEMS,

Davidson, B., Vieth, W., Wang, S., and Gilmore, R., Jr.

Rutgers University,
New Brunswick, New Jersey,
College of Engineering.

1974, 134 p, 29 fig, 6 tab, 126 ref, 5 append. Publication No. AD-A008 947.

A collagen-urease membrane complex of relatively stable enzymatic activity was successfully produced and evaluated for the treatment of urinous waste water. It was evaluated in a spiral wound biocatalytic reactor module integrated into a prototype system containing reverse osmosis and ion exchange processes. A synthetic urinous feed solution containing sodium chloride and urea was used for the evaluation. A transport model based on the assumptions of steady-state, plug-flow, and Michaelis-Menten kinetics and accounting for simultaneous mass transfer and biochemical reaction simulated the performance of the biocatalytic reactor module. The system produced overall urea removals of 75 to 80%. These results are better than can be achieved with a single component system of practical size. Sixty to 80% of the tryptophan was still intact within the matrix in the biocatalytic reactor after intermittent storage and use. An irreversible denaturation of the enzyme must also be occurring in order to account for the decline in enzymatic activity of the collagen-urease membrane complex. The effects of mass transfer were of the same order of magnitude throughout the flow regimes investigated.

*Waste water treatment, *Sewage treatment, *Treatment facilities, *Urine, *Sewage, Reverse osmosis, Ion exchange, Membranes, Enzymes, Model studies

Urease, Biocatalytic reactors

D150

FORMATION OF HALOGENATED ORGANICS BY CHLORINATION OF WATER SUPPLIES (A REVIEW),

Morris, J. C.

1975, 54 p. 166 ref. Technical Report PB 241 511.

Available literature relating to the formation of chlorinated organic compounds during chlorination of water was reviewed and assessed. A limited number of well-defined reactions occur on a few specific types of organic structures. Electrophilic aromatic substitution of positive chlorine and electrophilic addition of positive chlorine to appropriately activated double bonds are the identifiable initial reactions. The former reaction produces malodorous chlorophenolic compounds in intermediate stages, leading ultimately to oxidative ring rupture. The latter leads to chloroform and other haloforms as end products. Direct substitution reactions leading to the formation of exhaustively chlorinated hydrocarbons are unlikely. The known mechanisms do not result in such exhaustively chlorinated products as carbon tetrachloride or tetrachloroethylene. Possible methods for minimizing the concentrations of halogenated organic compounds include pre-treatment methods, such as coagulation or preozonation, to reduce amounts of their precursors and post-treatment methods, such as carbon adsorption or aeration, to remove halogenated compounds after their formation.

*Chlorination, *Chlorine, *Organic compounds, *Pollutant identification, *Water treatment, *Chemical reactions, Coagulation, Aeration, Adsroption, Bonding

Halogenated organics

D151

THE DEVELOPMENT OF A SIMPLE WASTE TREATMENT SYSTEM FOR U.S. NAVAL VESSELS,

Church, B. D., Griffin, L., Mack, D., and Espinosa, R.

Denver Research Institute,
Denver, Colorado.

1975, 43 p. 11 fig, 6 tab, 14 ref. Technical Report AD-A010-233.

An apparatus was developed in which shipboard wastes containing garbage, sanitary waste, and small amounts of crankcase oil was successfully digested by continuous fermentation. An initial chemical oxygen demand (COD) over 1000 mg/liter decreased to under 100 mg/liter in 6 hr. The process has potential advantages for scale-up for shipboard waste treatment. A limiting nitrogen level in the raw waste seriously restricted sludge development and waste material oxidation. Adding 0.05% heavy corn steep liquor overcame this problem. The best microbial sludge mass with regard to waste digestion treatment time and floc settling time, a natural enriched mass, developed from the wastes themselves.

*Waste water treatment, *Sewage treatment, *Biological treatment, *Treatment facilities, *Chemical oxygen demand, *Sewage, Fermentation, Sludge, Sludge digestion, Organic wastes

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D152

SYSTEM FOR TOTAL DIRECT RECYCLE OF SECONDARY MUNICIPAL WASTEWATER, VOL I — DESIGN CONCEPTS,

Mauk, C. E., Gandhi, S. L., and Legan, R. W.

Houston Research, Incorporated,
Houston, Texas.

1975, 157 p. 17 tab, 28 ref. Technical Report ADA-011 938.

The conversion of secondary municipal effluent from an existing conventional waste water treatment facility to a quality suitable for potable use was studied. Over 800 papers and reports on all advanced waste water treatment processes were acquired in a comprehensive literature survey. The important processes were summarized and evaluated. A set of potable water quality criteria parameters was defined for closed loop water reuse. Mathematical performance and cost models were compiled for the individual processes. Both microscreening and multimedia filtration were included for suspended solids removal. Air stripping of ammonia ion exchange by clinoptilolite, and nitrification/denitrification were included for nitrogen removal. Although many municipal plants may already have a lime treatment step or no phosphate problem, phosphate removal by lime treatment was included. Regeneration and nonregeneration of carbon were both considered for the removal of dissolved organic material with activated carbon. Reverse osmosis and ion exchange were included, but not electrodialysis, due to operational problems and the lack of large scale, long term data. While ozone is expected to be more effective and economical for disinfection than chlorine, adding ozone to drinking water is not currently practiced in the United States, and authorities favor chlorine because of its long term residual. Evaporation was used for brine disposal because nonevaporative processes are not generally applicable and may not be allowed in the future. Incineration and nonincineration options were included for sludge disposal. The 14 processes were included in a FORTRAN computer program for performing design calculations of optimal combinations of the processes.

D153

LSW-500 DISPOSAL OF AIR FORCE LIQUID WASTES,

Combustion Power Company, Incorporated,
Menlo Park, California.

1975, 137 p. 19 fig, 14 tab, 3 ref, 3 append. Technical Report AD-A010-429.

Thermal degradation of liquid wastes in a fluidized bed incineration system was investigated. The wastes studied included aircraft washrack waste; paint stripping waste; herbicide orange; petroleum, oil, and lubricant waste (POL); municipal garbage; and sewage sludge. Of these, POL wastes, herbicide orange, a portion of the paint stripping waste, and municipal garbage were identified as fuels, with enough heat energy to maintain the fluidized bed at operating temperature. Use of the fluidized bed incinerator to dispose of selected wastes was successful. POL and municipal wastes can be used without additional fuel to dispose of aircraft washrack waste, paint stripping wastes, and sewage sludge. Liquid waste fuels were injected in the lower 6 inches of the fluidized bed using the existing oil guns. Other liquid wastes were injected using the existing feed locations just above and below the secondary bed. Non-fuel liquid wastes could be disposed of at a rate of 148 gal/hr in the test system. Existing exhaust emission standards were met in all areas except particulate matter loading. A dry scrubber is recommended for use with such systems. Herbicide orange can be satisfactorily disposed of providing emission control can be maintained.

*Treatment facilities, *Sewage sludge, *Civil engineering, *Incineration, *Environmental engineering, Sludge disposal, Solid wastes, Smoke, Ultimate disposal, Liquid wastes, Oil wastes, Herbicides

Fluidized bed incineration, Orange herbicide

D154

WATER REUSE IN THE UNITED STATES,

Pringle, B. H.

Air Force Systems Command,
Wright-Patterson Air Force Base, Ohio,
Aerospace Medical Division.

1974, 89 p. 7 ref. Technical Report AD-A011 856.

The demand for water and the level of indirect water reuse in the United States have been increasing. There is also increased interest in direct reuse of treated water for domestic supply. Direct reuse is accomplished by recycling waste treatment plant effluents directly to the water treatment plant; indirect reuse involves the discharge of effluents to bodies or watersheds where it becomes available for use again. Neither the Environmental Protection Agency nor the American Water Works Association approved direct reuse in the early 1970's. Current drinking water standards do not consider the possible toxic elements and compounds likely to be found in waste water. Some of the key health factors to be considered include viruses, bacteria, other microorganisms, chemicals, and the reliability of plant operation. The kind of supply many advocate for reuse with no additional treatment could produce a 30% viral infection rate, and the infected individuals could then infect others. Bacteria, protozoa, and helminthes could also be spread by direct reuse. Most sewage treatment processes remove little of the chemicals disposed of in sewers. Waste water and water treatment plants are not sufficiently reliable. Failsafe treatment operations with monitoring and control should be provided.

*Waste water treatment, *Sewage treatment, *Water reuse, *Sewerage, *Treatment facilities, *Recycling, *Pathology, Toxicity, Public health, Water pollution effects, Waste water disposal

Environmental toxicology

D155

MODEL FACILITY PLAN FOR A SMALL, RURAL COMMUNITY,

1975, 36 p. 3 fig, 13 tab, 1 append. EPA Report MCD-08.

The pollution problems in Brant, South Dakota, are typical of those facing many small communities. Brant has a population of about 475 and no industry. Its sewage treatment plant, including a lift station, Imhoff tank, trickling filter, final settling tank, and sludge drying beds, was constructed in 1950. These facilities need major repairs to become operable; currently untreated sewage is discharged to a confined area. It was determined that excessive infiltration and inflow do not exist. The present system is not meeting state and Federal regulations, and the discharge of untreated sewage causes public health hazards and odor problems. The treatment alternatives considered were remodeling the existing treatment plant, replacing it with a 3-cell stabilization pond system, retention of all sewage in lagoons with no discharge, installing a waste treatment package plant, and applying treated waste water to land by spray irrigation. On the basis of environmental effects, monetary costs, effluent requirements, operational considerations, and the probable effects on the environment, the stabilization pond system was recommended.

*Waste water treatment, *Sewage treatment, *Sewerage, *Treatment facilities, *Rural areas, Alternative planning, Oxidation lagoons, Repairing, Retention, Waste water disposal, Land use

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D156

BIOLOGICAL TREATMENT OF WASTE WITH HIGH ASH CONTENT USING A HYDROLYTICALLY ASSISTED EXTENDED AERATION PROCESS,

Gaudy, A. E., Jr., Manickam, T. S., Saidi, H., and Reddy, M. P.

Oklahoma State University,
Stillwater,
School of Civil Engineering.

Biotechnology and Bioengineering, Vol. 18, No. 5, p 701-721, May, 1976. 7 fig, 3 tab, 10 ref.

A modified extended aeration process for biological treatment of wastes, in which autodigestion was aided and controlled by periodic partial hydrolysis of small portions of the recycle sludge, was previously demonstrated to be feasible using an artificial waste containing little suspended organic solids. To test the process for wastes with high organic feed content and ash content, a 1.5 year pilot study was made using hydrolyzed trickling filter sludge. Analyses were performed for chemical oxygen demand (COD), biochemical oxygen demand (BOD), TOC, suspended solids, ammonia nitrogen, organic-nitrogen, and nitrite-nitrogen. Ash contents in the activated sludge were higher, but did not continually increase or adversely affect the efficiency of organic matter removal. They may have enhanced separation in the final clarifier, since there was little trouble in separating mixed liquor at concentrations over 20,000 mg/liter. COD and suspended solids removal and BOD samples indicated that the system provided waste water purification comparable to other activated sludge processes operating on wastes of much lower ash content. The high dissolved inorganic solids concentration in the effluent is apparently amenable to further physical-chemical treatment. Several further treatment processes were investigated. Ion exchange appears to favorably reduce solids, and, while activated carbon adsorption was relatively ineffective in solids removal, it was extremely effective in removing color.

D157

TECHNICAL REVIEW OF THE USE OF OXYGEN IN THE TREATMENT OF WASTE WATER,

Boon, A. G.

Water Research Center,
United Kingdom,
Stevenage Laboratory.

Water Pollution Control, Vol. 75, No. 2, p 206-213, 1976. 1 fig, 2 tab, 34 ref.

Advantages and disadvantages associated with the use of oxygen in waste water treatment applications involving activated sludge processes, river protection, and the maintenance of aerobic conditions in rising-main sewers are discussed. Waste waters containing high biochemical oxygen demand concentrations (greater than 1000 mg/liter) can be treated very economically with oxygen activated sludge processes. Moreover, the settleability of sludge from oxygenated plants is better than that of sludge from air activated sludge plants, and the volume of surplus sludge is lower with oxygen processes. The injection of oxygen to maintain aerobic conditions in rising-main sewers is in some cases economically more advantageous than the use of air injection. Oxygen can be used to increase the oxygenation capacity of treatment plants, rivers, or lagoons in emergency situations at a lower cost than that associated with aeration systems. Disadvantages connected with the use of oxygen include: increased complexity, increased energy consumption, difficulties associated with achieving nitrification in oxygenated activated sludge plants, and the hazards connected with storing and using oxygen.

*Oxygen, *Sewers, *Activated sludge, *Waste water treatment, *Aerobic treatment, Biological treatment, Treatment facilities, Water quality control, Rivers, Treatment, Evaluation, Biochemical oxygen demand, Sludge, Lagoons, Nitrification

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D158

DESIGN CRITERIA FOR MICROSCREENING BIOLOGICAL WASTEWATER PLANT EFFLUENTS,

Ewing, L.

Ewing Engineering Company,
Milwaukee, Wisconsin.

Water and Sewage Works, Reference number, p R-94-R-96, R-98-R-101, April 30, 1976. 3 fig, 3 tab, 6 ref.

Factors affecting the performance of horizontal rotary drum type microscreens used in biological waste water plants are reviewed along with operating and performance data obtained at two activated sludge plants using microscreens. Major variables affecting the removal efficiency of microscreens and/or effluent quality include: biological loading of the upstream process, final clarifier hydraulic loading, flocculation procedures, hydraulic head across screen media, upstream hydraulics, effectiveness of the solids collection system, media aperture, screen peripheral speed, and raw waste water characteristics. Variables affecting screen capacity expressed as gallons/min/ft of width include: type of biological process and loading, screen influent suspended solids concentration, media effective open area, peripheral speed, effectiveness of cleaning system and solids removal system, head across screen media, media aperture, temperature, and diameter or length of submerged arc. Data obtained from an activated sludge facility using a microscreen for tertiary treatment revealed effluent suspended solids and biochemical oxygen demand concentrations of less than 5 mg/liter under normal operating conditions. The screen successfully handled plant effluents with suspended solid concentrations up to 80 mg/liter.

*Screens, *Biological treatment, *Waste water treatment, *Activated sludge, *Tertiary treatment, Physical properties, On-site investigations, Treatment facilities, Equipment, Performance, Evaluation, Solid wastes, Waste treatment, Treatment, Biochemical oxygen demand

D159

DEVELOPMENT IN THE APPLICATION OF OXYGEN IN THE ACTIVATED-SLUDGE PROCESS IN THE FEDERAL REPUBLIC OF GERMANY,

Hegemann, W., and Bischofsberger, W.

Water Pollution Control, Vol. 75, No. 2, p 221-226, 1976. 2 fig, 4 tab, 10 ref.

The treatment of domestic and industrial wastes with an oxygen activated sludge process was investigated at a number of waste treatment plants throughout West Germany. Retention periods in oxygenation tanks were shorter due to higher decay rates with oxygen activated sludge operation. Lower biomass loadings were also observed for a given tank size, implying that smaller tank volumes are possible with the oxygen activated sludge process. Specific surplus sludge production was reduced with the oxygen process, with solids production amounting to only about 50% of that associated with conventional air plants. The settleability of most oxygen sludges, as indicated by the sludge volume index, was better than that of air sludges. The oxygen process appeared to be inadequate, however, in applications where nitrification was required.

*Activated sludge, *Oxygen, *Oxidation, *Waste treatment, Sludge, Domestic wastes, Industrial wastes, Treatment facilities, Biomass, Physical properties, Evaluation, On-site investigations, Performance

Sludge volume index, Settling characteristics, Oxygen activated sludge

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D160

SODIUM BICARBONATE DOSES UPGRADE PLANT TO '77 STANDARDS,

Water and Sewage Works, Reference number, p R-64-R65, April 30, 1976.

Field tests at a gravity flow trickling filter sewage treatment plant were conducted to assess the effect of sodium bicarbonate addition to the process on the level of biochemical oxygen demand. The addition of 4 lb/hr of sodium bicarbonate to the waste stream as it passed through the bar screen reduced the biochemical oxygen demand from 15-25 mg/liter to less than 10 mg/liter, the latter figure being in compliance with the 1977 Environmental Protection Agency standards. This reduction was the result of the buffering capacity of sodium bicarbonate to neutralize the fatty acids in the waste. Tests involving the addition of 100 lb of sodium bicarbonate to the plant's sludge digester each day were also conducted. This addition resulted in the alkalinity being increased from about 1400-1500 mg/liter to as high as 2500 mg/liter, with the pH being maintained between 6.6 and 6.7. This in turn resulted in better solids/liquid separation, a finer particle cake, less odor, and an increase in methane production from 800-900 cu ft/day to 4000 cu ft/day.

*Sewage treatment, *Sodium compounds, *Neutralization, *Alkalinity, *Bicarbonates, Evaluation, On-site investigations, Trickling filters, Performance, Treatment, Biochemical oxygen demand, Chemical properties, Efficiencies, Sludge, Sludge digestion, Methane

Sodium bicarbonate

D161
IMPROVING THE FUEL VALUE OF SEWAGE SLUDGE,

Hathaway, S. W., and Olexsey, R. A.

United States Environmental Protection Agency,
Cincinnati, Ohio,
Municipal Environmental Research Laboratory.

News of Environmental Research in Cincinnati, October 31, 1975, 4 p. 3 fig, 2 tab, 8 ref.

The cost of auxiliary fuel is an increasingly crucial component of the cost of incinerating municipal sewage sludge. Auxiliary fuel is needed because, even after dewatering, more heat is required to evaporate the entrained water than the sludge solids can provide. Sludge volatility also affects the combustibility of the sludge cake. Less expensive alternative auxiliary fuels are being considered, including coal, municipal refuse, wood chips, and paper products. The use of incinerator ash for sludge conditioning does not remove the need for auxiliary fuels, because the ash must be heated and has no beneficial heat value. Sewage sludge is very compressible, and the compressed floc particles hinder dewatering by making the filter medium less porous. Sludge treatment with an incompressible substance is beneficial because it reduces this effect. Granulated coal with a maximum particle size of 9.5 mm, was added to liquid sludge in dosages ranging from 0.2 to 1.0 kg coal/kg dry sludge solids. When coal dosage was above 0.3 kg coal/kg sludge solids, the combustion of the sludge cake provided sufficient energy to supply the heat needed for incineration. The addition of coal in this particle size range did not produce a startling increase in filter yield. Results from a pilot plant show that without polymer, coal addition does not affect the net yield of sludge solids, but that the addition of polymer significantly increases yield. The cost for coal addition is estimated at $10/metric ton dry sludge solids. The cost of oil as a supplementary fuel is estimated at $17.50/metric ton of dry solids. Coal cannot, in itself, serve as a complete conditioning agent.

*Sewage sludge, *Fuels, *Costs, *Incineration, *Sludge disposal, Ultimate disposal, Dewatering, Sludge treatment

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D162
SUMMARY: TECHNOLOGICAL ALTERNATIVES FOR WATER SUPPLY AND WASTEWATER DISPOSAL IN THE COASTAL AREA,

Edge, B. L.

Clemson University,
Clemson, South Carolina,
Department of Civil Engineering.

In: Proceedings of the Southeastern Conference on Water Supply and Wastewater in Coastal Areas, April 2-4, 1975, Wilmington, North Carolina, University of North Carolina, p 124-132.

Technological alternatives for waste water disposal in coastal areas are reviewed. Recycling appears to be attractive for the disposal of most wastes in coastal areas, though ocean disposal techniques that cause minimal damage to the ecosystem may be necessary for some types of wastes. Evidence indicating that life in the oceans has diminished by as much as 50% in the last 20 years, however, argues against the indiscriminate use of ocean outfalls. Subsurface waste disposal using septic tanks is considered generally unfeasible for coastal areas, particularly high-priced ocean front areas. Deep well disposal is another alternative for waste disposal in coastal areas; however, more information is required to assess the effect of high pressures and long residence times on the possible production of hazardous compounds from wastes injected into deep wells. The possible emergence of aquifers into the ocean must also be considered in terms of disrupting the ecosystem.

*Waste water disposal, *Waste water treatment, *Coasts, *Oceans, Recycling, Septic tanks, Injection wells, Aquifers, Ecosystems, Chemical reactions, Water pollution effects

D163
THE ROLE OF CONVENTIONAL WASTEWATER TREATMENT IN COASTAL AREAS,

Brown, J. C.

North Carolina University,
Chapel Hill,
Wastewater Research Center.

In: Proceedings of the Southeastern Conference on Water Supply and Wastewater in Coastal Areas, April 2-4, 1975, Wilmington, North Carolina, University of North Carolina, p 75-86. 1 tab, 8 ref.

An evaluation of the role of conventional waste water treatment in coastal area water quality management is presented. Secondary treatment appears to be sufficient for maintaining current water quality standards, and additional processes can be added to conventional treatment plants for the removal of nitrogen or phosphorus as nutrient discharge limitations are developed in the future. When removal of nutrients is not technically or economically feasible at a treatment plant, conventional secondary treatment can serve as a pre-treatment for ultimate disposal by land-spreading methods. Ocean outfalls offer the most environmentally and ecologically attractive solution for permanent and resort communities located close to the ocean, with conventional treatment methods serving as pre-treatment for ultimate disposal in the ocean.

*Waste water treatment, *Waste water disposal, *Coasts, *Treatment facilities, Oceans, Outlets, Nitrogen, Phosphorus, Evaluation, Water quality control, Water spreading

Pre-treatment

D164
SHALLOW SUBSURFACE DISPOSAL OF WASTEWATER,

Turnage, A. C., Jr.

North Carolina Department of Natural and
Economic Resources,
Division of Environmental Management.

In: Proceedings of the Southeastern Conference on Water Supply and Wastewater in Coastal Areas, April 2-4, 1975, Wilmington, North Carolina, University of North Carolina, p 60-67.

The use of shallow subsurface systems for the disposal of waste water in coastal areas is discussed. Septic tank-nitrification line systems appear to be suitable for low-density coastal areas where the proper soil structure exists and where adequate separation from surface waters and groundwaters can be maintained. Particular attention must be paid to the possible presence of a compacted muck or vegetative layer underlying sand fills because of the likelihood of an impervious interface, resulting in the horizontal movement of effluent. Indiscriminate and unwise development where septic tank systems are used poses a potentially serious danger of contaminating the adjacent waters with fecal coliform and viruses. The introduction of treated waste water to the soil subsurface is another method of shallow disposal in coastal areas, though this method is considered mainly as an interim solution to waste disposal, pending the development of regional sewage collection and treatment systems with ocean outfalls. Regulations and design criteria for shallow subsurface systems established by the North Carolina Environmental Management Commission are outlined.

*Waste water disposal, *Coasts, *Soil disposal fields, *Septic tanks, *Waste water treatment, *Subsurface flow, Nitrification, Disposal, Treatment, Coliforms, Viruses, Design criteria, Regulation

D165
LAND DISPOSAL OF WASTEWATER,

Humenik, F. J.

North Carolina State University,
Raleigh,
Biological and Agricultural Engineering Department.

In: Proceedings of the Southeastern Conference on Water Supply and Wastewater in Coastal Areas, April 2-4, 1975, Wilmington, North Carolina, University of North Carolina, p 48-59. 3 fig, 4 tab.

The use of land application for the disposal of municipal and industrial waste water is discussed. Terminal disposal via land irrigation is limited either by the hydraulic or process load. The higher the degree of pretreatment provided or the lower the concentration of nitrogen, the more hydraulic loading predominates as the controlling factor; whereas, hydraulic load becomes insignificant when dealing with waste water that has a high concentration of any constituent that affects the plant-soil receiver system. Aerated ponds can provide significant pretreatment at a very low cost. Up to 85% nitrogen removal in pond systems appears possible with minimum horsepower requirements for complete surface agitation. Pond systems are also effective for heavy metal removal if the organic waste input is high and the organic metal complex remains in the bottom sludge. It is not always best to treat waste water to as high a degree as possible before discharge to streams because land-based systems can provide a more economical alternative. The use of land application as a substitute for tertiary treatment of nitrogen, phosphorus, metals, and solids appears to be a much less expensive method of meeting current regulatory criteria in most areas.

*Waste water disposal, *Irrigation, *Waste water treatment, *Aeration, *Ponds, Municipal wastes, Industrial wastes, Nitrogen, Heavy metals, Phosphorus, Solid wastes

Hydraulic loading, Land disposal, Process load

D166
OCEAN OUTFALL DISPOSAL SYSTEMS,

Feuerstein, D. L.

Engineering-Science, Incorporated,
Berkeley, California.

In: Proceedings of the Southeastern Conference on Water Supply and Wastewater in Coastal Areas, April 2-4, 1975, Wilmington, North Carolina, University of North Carolina, p 12-26. 2 fig, 1 tab.

A theoretical examination of mechanisms affecting the diminution of waste water constituents discharged from ocean outfalls is presented along with an evaluation of the efficacy of submarine outfall disposal systems for East Coast conditions. Mathematical expressions are derived for predicting the initial dilution occurring in the immediate vicinity of a diffuser, subsequent dilution resulting from lateral dispersion, and diminution caused by the disappearance or decay of non-conservative waste water constituents. Proper diffuser design is shown to be capable of effecting dilutions on the order of 50 to 100 in the initial mixing zone. The use of waste water treatment facilities in conjunction with outfall discharge is also considered, and it is shown that increasing treatment levels can be matched with decreasing dilution capacities of disposal facilities to satisfy the same receiving water quality objectives. Submarine outfall disposal systems on the East Coast appear to be cost-effective and are recommended for evaluation.

*Waste water disposal, *Waste water treatment, *Coasts, *Waste dilution, *Atlantic Ocean, *Outlets, *Mathematical models, *Dispersion, *Diffusion, Design criteria, Disposal, Treatment, Feasibility, Cost-benefit analysis, Evaluation

D167

WATER SUPPLY AND WASTEWATER DISPOSAL - PLANNING AND PROBLEMS - IN COASTAL AREAS,

Denison, P. S.

Henry von Oesen and Associates, Incorporated,
Consulting Engineers and Planners,
Wilmington, North Carolina.

In: Proceedings of the Southeastern Conference on Water Supply and Wastewater in Coastal Areas, April 2-4, 1975, Wilmington, North Carolina, University of North Carolina, p 7-11.

A review of water supply and waste water disposal problems in coastal areas of the United States is presented, with particular emphasis on the North Carolina area. Limited local groundwater supplies in beach communities of North Carolina are diminishing such that plans are underway to augment these supplies with additional potable water transported from more productive mainland areas. Discharges of domestic sewerage wastes into the coastal soils are beginning to adversely affect fragile estuarine waters; the most viable solution to the problem appears to be the collection and treatment of such wastes, followed by disposal of the effluent residual into the Atlantic Ocean via outfalls. Local and regional water supply and waste water treatment planning programs throughout North Carolina are outlined.

*Water supply, *Waste water treatment, *Domestic wastes, *Sewerage, *Waste water disposal, *Coasts, *Outlets, Atlantic Ocean, Atlantic coastal plain, North Carolina, Planning, Programs, Oceans, Treatment, Sewage treatment, Estuarine environment, Estuaries

Regional planning

D168

INHIBITION OF NITRIFICATION BY AMMONIA AND NITROUS ACID,

Anthonisen, A. C., Loehr, R. C., Prakasam, T. B. S., and Srinath, E. G.

MONTECO Environmental Management Associates,
Montgomery, New York.

Journal Water Pollution Control Federation, Vol. 48, No. 5, p 835-852, May, 1976.
15 fig, 4 tab, 24 ref.

The inhibitory effects of ammonia and nitrous acid on nitrification, a process which may occur during waste treatment, were investigated. Nitrification inhibition was correlated with free ammonia and free nitrous acid concentrations but not with total ammonia or nitrite ion concentrations. The free ammonia concentrations required for the inhibition of nitrosomonads and nitrobacters were 10-150 mg/liter and 0.1-1.0 mg/liter, respectively. Inhibition of nitrifying organisms by free nitrous acid was initiated at concentrations between 0.22 and 2.8 mg/liter. Factors affecting the inhibition of nitrification by free ammonia and free nitrous acid included acclimation of the nitrifiers to the inhibitors, temperature, and the number of active nitrifying organisms. Free ammonia and free nitrous acid inhibition of nitrification occurs in municipal, industrial, and agricultural wastes as well as with fertilizers in the soil.

*Nitrification, *Inhibitors, *Inhibition, *Ammonia, *Nitrogen fixing bacteria, Waste treatment, Temperature, Microorganisms, Municipal wastes, Industrial wastes, Farm wastes, Soils, Fertilizers, Chemical reactions

Nitrous acid, Nitrites, Nitrifiers

D169
AWT ENERGY NEEDS A PRIME CONCERN,

Argo, D. G., and Wesner, G. M.

Orange County Water District,
Fountain Valley, California.

Water and Wastes Engineering, Vol. 13, No. 5, p 24-26, 77, May, 1976. 2 fig, 1 tab.

Primary and secondary energy requirements are outlined for an advanced design waste water treatment plant designed to treat 15 million gallons/day of trickling filtered secondary effluent by chemical clarification with lime, ammonia stripping, recarbonation, mix-media, filtration, carbon adsorption, and chlorination. Energy consumptions for the influent pump station, the chemical clarification system, ammonia removal towers, the recarbonation basin, the filtration system, activated carbon adsorption, and chlorination are 2688, 842, 27,988, 4370, 412, 3566, and 91 kilowatt-hours/day, respectively. A reverse osmosis system is being installed to demineralize one-third of the plant's flow and is expected to consume about 35,000 kilowatt-hours/day. Detailed diagrams of the reclamation plant and the reverse osmosis section are presented.

*Waste water treatment, *Tertiary treatment, *Treatment facilities, *Energy budget, Adsorption, Filtration, Chlorination, Pumps, Equipment, Reverse osmosis, Facilities, Recycling

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D170
THE SIGNIFICANCE OF PORE DIFFUSION TO FILTER DENITRIFICATION,

Harremoes, P.

Denmark Technical University,
Lyngby,
Department of Sanitary Engineering.

Journal Water Pollution Control Federation, Vol. 48, No. 2, p 377-388, February, 1976. 9 fig, 1 tab, 15 ref.

The kinetics of filter denitrification are reviewed, and a mathematical expression relating pore diffusion to filter denitrification is developed. An expression for a bulk half-order reaction based on zero-order heterogeneous reactions in a pore which is only partly penetrated by the substrate is found to be suitable for simulating filter denitrification. The applicability of the theory is demonstrated by a comparison with filter concentration profiles and with the half-order bulk reaction rate per unit filter surface. Values of the half-order bulk reaction rate ranging over 4 orders of magnitude are demonstrated for differences in media type and size, porosity, specific surface, residence time, scale of experiment, and temperature. The design of denitrification filters with respect to choice of media and residence time is shown possible by selection of the proper reaction rate.

*Denitrification, *Filters, *Design criteria, *Mathematical models, *Kinetics, Waste treatment, Chemical reactions, Physical properties, Biological treatment, Pores, Diffusion

Filter denitrification

D171
A FORCED AERATION SYSTEM FOR COMPOSTING WASTEWATER SLUDGE,

Epstein, E., Willson, G. B., Burge, W. D., Mullen, D. C.,
and Enkiri, N. K.

U.S. Department of Agriculture,
Beltsville, Maryland,
Biological Waste Management and
Soil Nitrogen Laboratory.

Journal Water Pollution Control Federation, Vol. 48, No. 4, p 688-694, April, 1976.
8 fig, 5 ref.

Studies investigating the use of forced aeration for composting raw waste water sludge without the release of odors are reported. Suction applied early during composting in a pile insulated with screened compost avoids the release of odorous gases to the atmosphere. Destruction of total coliforms, fecal coliforms, and salmonellae is much greater with the forced aeration method than it is with windrow composting. A survival of microorganisms in the lower corner of the pile is believed to be a result of a lack of insulation or compost depth and the resulting heat loss in this section. Most of the temperatures recorded are in the thermophilic range. Efforts are underway to achieve more uniform temperatures throughout the piles by modifying the suction system.

*Aeration, *Sludge treatment, *Odor, *Coliforms, *Salmoneall, Waste treatment, Microorganisms, Biological treatment, Temperature, Temperature control, Waste water treatment

Forced aeration, Composting

D172
RESPONSE OF ACTIVATED SLUDGE TO QUANTITATIVE SHOCK LOADING,

Krishnan, P., and Gaudy, A. F., Jr.

Roy F. Weston, Incorporated,
Wilmette, Illinois.

Journal Water Pollution Control Federation, Vol. 48, No. 5, p 906-919, May, 1976.
9 fig, 3 tab, 16 ref.

The effect of quantitative shock loading, administered as a step increase in feed concentration, on both once-through and cell recycle activated sludge systems was investigated for various hydraulic reactor detention times. As the detention time was increased, there was generally an improvement in system response with regard to the amount of substrate leakage during the transient phase at a given shock concentration of substrate. This trend was most readily observed in the once-through systems, although it was also seen in the cell recycle systems at high shock levels. Cell recycle operation appeared to have some beneficial effect with regard to transient substrate leakage at the 3000 mg/liter level; however, a 5000 mg/liter shock level exceeded the ability of the cell recycle program to attenuate substrate leakage over that observed in the once-through system. The results indicate that activated sludge systems may be expected to accommodate a 200% increase in feed concentration with little or no substrate leakage in the transient phase.

*Activated sludge, *Waste water treatment, *Feeding rates, Performance, Evaluation, Treatment facilities, Equipment, Treatment

Quantitative shock loading, Substrate leakage

D173

BIOLOGICALLY MEDIATED INCONSISTENCIES IN AERATION EQUIPMENT PERFORMANCE,

Matson, J. V., Bennett, G. F., Albertson, O. E., and
Di Gregorio, D.

Journal Water Pollution Control Federation, Vol. 48, No. 5, p 966-970, May, 1976.
3 tab, 7 ref.

Experimental evidence to refute the conclusion that microorganisms can and do utilize oxygen directly from bubbles is presented in response to results reported from measurements of oxygen uptake rates in biological waste water treatment reactors. Data from pilot plant studies comparing oxygen uptake rates by the oxygen electrode and chemical oxygen demand balance in activated sludge treatment systems illustrate no significant differences between the oxygen usage by chemical oxygen demand balance and that measured by the electrode. If a direct oxygen pathway existed, oxygen usage by chemical oxygen demand balance should have been greater. The calculation of oxygen uptake rates in both sparged and unsparged reaction conditions also fail to show a direct oxygen transfer pathway. Thus, an accumulation of evidence suggests that a direct oxygen transfer pathway, if it does exist, is not significant under a variety of experimental conditions.

*Waste water treatment, *Biological treatment, *Aeration, *Activated sludge, *Microorganisms, *Oxygen, *Equipment, Rates, Chemical oxygen demand, Kinetics, Measurement, Chemical reactions, Bubbles

Oxygen uptake rates

D174

FOLKLORE IN THE DESIGN OF FINAL SETTLING TANKS,

Dick, R. I.

Delaware University,
Newark,
Civil Engineering Department.

Journal Water Pollution Control Federation, Vol. 48, No. 4, p 633-644, April, 1976.
3 fig, 30 ref.

Empirical parameters which have been found useful in the past for describing the performance of final settling tanks in activated sludge processes are evaluated in light of current knowledge on the subject. Stipulation of some maximum overflow rate and minimum retention time seems reasonable, but only for a description of the clarification function of the tank. These parameters completely disregard the thickening function of the tank. The use of sludge volume index as a basis for estimating the concentration of return sludge to be expected from a final settling tank appears questionable because it does not take into account the designer's and the operator's ability to alter the performance of final settling tanks to achieve a range of return sludge concentrations. The concept that solids retention time must be minimized in final sedimentation tanks does not seem well founded except as it relates to the possible flotation of sludge caused by denitrification and to the release of phosphorus from sludges. The popular idea that overflow rates in final sedimentation tanks should be selected to be equivalent to the settling velocity of the mixed liquor is theoretically incorrect and may result in inaccurate sedimentation tank design.

*Sedimentation, *Settling basins, *Activated sludge, *Waste water treatment, *Design criteria, Retention, Rates, Performance, Evaluation, Treatment, Equipment, Flotation, Phosphorus, Settling velocity

Settling tanks

D175

ONE- VERSUS TWO-STATE NITRIFICATION IN THE ACTIVATED SLUDGE PROCESS,

Stover, E. L., and Kincannon, D. F.

Oklahoma State University,
Stillwater,
School of Civil Engineering.

Journal Water Pollution Control Federation, Vol. 48, No. 4, p 645-651,
April, 1976. 6 fig, 17 ref.

A literature search and laboratory experiments were performed to evaluate the relative merits of one- versus two-stage nitrification in activated sludge processes. Both one- and two-stage systems were found capable of achieving complete nitrification and a high level of carbon removal. The operational difference between the two processes was simply the value of the limiting mean cell residence time or growth rate. The limiting mean cell residence time for complete nitrification was six days for the two-stage process and ten days for the one-stage process. The one-stage process appears to offer some advantages if sludge disposal presents a difficult or costly problem and only requires one clarifier. However, nitrification may be possible in a two-stage process when it is not possible in a one-stage system. A problem encountered in both the one- and two-stage processes is pH reduction by the production of nitric acid. If insufficient alkalinity is present in the waste water, the one-stage system and the nitrification reactor of the two-stage system will require pH adjustment.

*Nitrification, *Activated sludge, *Waste water treatment, *Kinetics, Sludge disposal, Costs, Alkalinity, Acids, Evaluation, Performance, Laboratory tests

Nitric acid, Literature reviews

D176

AEROBIC THERMOPHILIC TREATMENT OF HIGH STRENGTH WASTEWATERS,

Surucu, G. A., Chian, E. S. K., and Engelbrecht, R. S.

Middle East Technical University,
Ankara, Turkey,
Department of Environmental Engineering.

Journal Water Pollution Control Federation, Vol. 48, No. 4, p 669-679,
April, 1976. 7 fig, 1 tab, 29 ref.

The feasibility of using aerobic thermophilic treatment, a modification of the conventional activated sludge process, for purifying waste waters with high concentrations of organic matter was evaluated using a single-stage, isothermal, completely mixed, continuous-flow reaction system. The thermophilic system proved capable of treating waste water with a high organic content in less time than that required for mesophilic systems and produced less sludge. Over 90% removal of soluble chemical oxygen demand was observed with a sludge retention time of 2 days. The percentage removal of chemical oxygen demand increased with increasing sludge retention times. The theoretical air requirements for thermophilic systems are expected to be slightly higher (14%) than for mesophilic systems because of the higher rate of endogenous respiration at elevated temperatures.

*Waste water treatment, *Aerobic treatment, *Thermophilic bacteria, *Organic compounds, Activated sludge, Chemical oxygen demand, Rates, Kinetics, Temperature, Respiration, Efficiencies, Performance, Feasibility

Aerobic thermophilic treatment

D177
LAND APPLICATION RESEARCH AT ROBERT S. KERR ENVIRONMENTAL RESEARCH LABORATORY,

Thomas, R. E., and Harlin, C. C., Jr.

Robert S. Kerr Environmental Research Laboratory,
Ada, Oklahoma,
Water Quality Control Branch.

In: Land Application of Wastewater, November 20-21, 1974, Newark, Delaware, p 3-12. 22 ref.

Research being conducted by the Robert S. Kerr Environmental Research Laboratory for the Environmental Protection Agency to evaluate various methods of waste water management which incorporate land application are outlined. Crop irrigation is being investigated in terms of locating and evaluating currently available quantitative information on application rates, crop responses, soil changes, and groundwater quality changes. Projects designed to demonstrate crop irrigation approaches in geographic areas where historical information is scarce are also being conducted. Infiltration-percolation investigations include four studies in water-short southwestern states and two studies in water-rich north central states. These studies involve assessing the effectiveness of the infiltration approach for direct recharge of a potable groundwater supply with secondary effluent, evaluating the use of infiltration-percolation for rendering municipal effluent suitable for filling and maintaining the water level of recreational lakes, and evaluating existing infiltration-percolation facilities. Projects designed to assess the feasibility of treating raw sewage by overland flow are also being conducted in addition to basic research on phosphorus retention in soils, denitrification, biodegradation of organics, and climatology.

*Waste water treatment, *Waste water disposal, *Percolation, *Infiltration, *Irrigation, *Overland flow, Research priorities, Programs, Groundwater, Lakes, Municipal wastes, Denitrification, Biodegradation, Organic compounds, Sewage treatment, Phosphorus

Land application

D178
LAND APPLICATION PRACTICES AND DESIGN CRITERIA,

Pound, C. E., and Crites, R. W.

Metcalf and Eddy, Incorporated,
Palo Alto, California.

In: Land Application of Wastewater, November 20-21, 1974, Newark, Delaware, p 13-26. 4 fig, 5 tab, 19 ref.

Engineering criteria for the design of waste water treatment and disposal systems involving land application are outlined. Irrigation, infiltration-percolation, and overland flow techniques are reviewed in terms of site characteristics, climatic factors, waste water loss, crop production, expected treatment performance, liquid loading rates, soil type, and applicable water quality criteria. A preliminary analysis of an actual case study is included to illustrate how these different land application methods can be combined to overcome restrictions in topography, soil permeability, water quality criteria, and construction costs. Emphasis is placed on considering land treatment methods as unit processes and selecting treatment methods so as to provide a design that is tailored to the specific site.

*Irrigation, *Infiltration, *Percolation, *Overland flow, *Waste water treatment, Waste water disposal, Design criteria, Costs, Soil properties, Water quality, Sites, Performance, Evaluation

Land application

D179

EXPERIENCES AT PENN STATE WITH LAND APPLICATION,

Sopper, W. E.

Pennsylvania State University,
University Park,
School of Forest Resources.

In: Land Application of Wastewater, November 20-21, 1974, Newark, Delaware, p 39-51.
14 tab, 9 ref.

The results of experiments involving the spray irrigation of cropland and forested areas with treated municipal sewage effluent are presented. Combinations of agronomic and forested areas appear to provide the greatest flexibility for waste recycling operations. Such systems are more adaptable to small cities and suburbs than to large metropolitan areas because of the availability of open land close to the waste water treatment plant in the former case. However, the land area requirement is not a major prohibitive factor. At the recommended level of irrigation (5 cm/week), only 52 hectares of land is required for the disposal of 4 million liters of waste water/day. Major metropolitan areas may be able to utilize golf courses, playing fields, forest preserves and parks, greenbelts, scenic parkways, and perhaps even divided highway and beltway medial strips for waste water disposal. The experimental results also indicate that municipal waste water might be used to reclaim and revegetate many of the barren bituminous strip mined spoil banks and anthracite refuse banks existing throughout the Appalachian region and restore them to a more esthetic and productive state.

*Sewage disposal, *Recycling, *Irrigation, Municipal wastes, Waste water treatment, Waste water disposal, Land reclamation, Evaluation, Water management, Water supply, Forests

Spray irrigation, Land application

D180

OVERLAND FLOW TREATMENT OF WASTEWATER - A FEASIBLE APPROACH,

Hunt, P. G. and Lee, C. R.

U. S. Army Engineer Waterways Experiment Station,
Vicksburg, Mississippi,
Environmental Effects Laboratory.

In: Land Application of Wastewater, November 20-21, 1974, Newark, Delaware,
p 71-83. 13 fig, 17 ref.

The use of overland flow for the treatment and disposal of waste water is discussed in terms of its theoretical basis and system operation. In an overland flow system, the waste water is applied at the top of gentle sloping hills and is allowed to flow over the soil surface down to collection channels. The treatment is represented by an intimate interaction among the soil surface layer, surface organic mat, plants, and microorganisms. The common length of the slope is 100-300 ft, and normally the system is employed on slopes ranging from 2-8%. Application rates are low, generally less than 0.5 acre-in/day; waste water, however, is applied for 5 days/week so that the weekly application rate is about 2.5 acre-in. The ability to monitor waste water as it leaves the treatment site is an especially valuable characteristic of overland flow systems. Most of the treated waste water is available at central collection channels for quality determinations and for discharge or other uses. The cost of overland flow systems is about $2000/acre.

*Overland flow, *Waste water treatment, *Waste water disposal, *Recycling, Monitoring, Flow, Water quality, Costs, Microorganisms, Soils, Surfaces

Land application

D181
INFILTRATION-PERCOLATION SYSTEMS,

Bouwer, H.

Department of Agriculture,
Phoenix, Arizona,
Water Conservation Laboratory.

In: Land Application of Wastewater, November 20-21, 1974, Newark, Delaware,
p 85-92. 4 fig, 11 ref.

The use of infiltration-percolation systems for the treatment and disposal of waste water is discussed. The waste water in infiltration-percolation systems is applied at much higher rates (0.3-3.0 m/week) than with low-rate or irrigation-type systems, resulting in the obvious advantage of low land requirements (1-10% of that for low-rate systems). High-rate systems require relatively permeable soil such as sandy loams to medium sands. The transmissibility of the underlying aquifer should also be sufficiently high to conduct the water laterally away from the infiltration area without undue water table rises. Another advantage of high-rate systems is that the infiltration rates are much higher than the evapotranspiration rate. Because of the high hydraulic loading rates in high-rate systems, the amounts of nitrogen, phosphorus, and other elements entering the ground with the waste water are much higher than crops can remove. Thus, special management techniques are required to stimulate denitrification of nitrate and immobilization of phosphate in the soil to yield renovated water of acceptable quality. It may be desirable to restrict the spread of the renovated water into the groundwater basin by selecting the infiltration site so that the renovated water drains into surface water.

*Infiltration, *Percolation, *Waste water treatment, *Waste water disposal, *Recycling, Rates of application, Infiltration rates, Hydraulics, Nitrogen, Phosphorus, Nitrates, Phosphates, Denitrification

Land application

D182
LAND APPLICATION OF TREATED SEWAGE IN THE MOUNTAIN STATE,

Light, E.

Campaign Clean Water,
Charleston, West Virginia.

In: Land Application of Wastewater, November 20-21, 1974, Newark, Delaware,
p 93-94. 7 ref.

The feasibility of using land application techniques (overland flow, spray irrigation) for the treatment of municipal sewage wastes in the state of West Virginia is discussed. Objections to land treatment in the state because of the topography, climate, and soil of the Appalacian Mountains are cited as being invalid based on the success of land application techniques in other areas of the country with similar problems. About one-third of the soil scattered throughout the Appalachians is estimated to be suitable for land treatment. Erosion is not expected to be a problem in West Virginia if application rates are not too high since the state is heavily forested. The state's strip mines and coal refuse piles are considered prime land treatment sites. Since 70 cities in West Virginia will be required to go to advanced treatment, land application of municipal wastes is proposed as a feasible alternative that is economically realistic.

*Sewage treatment, *Sewage disposal, *Municipal wastes, *Overland flow, *Irrigation, *West Virginia, Soils, Topography, Climates, Land reclamation, Mountains, Application rates, Feasibility

Land application

D183

DEBATE GROWS OVER WATER PURIFICATION METHODS,

Chemical and Engineering News, Vol. 54, No. 26, p 34, 39, June 21, 1976.

Criteria for achieving disinfection of water and waste water were discussed at a forum sponsored by the International Ozone Institute. Waste water disinfection has been defined as the reduction of virus and fecal coliform bacteria concentrations to acceptable levels. In the United States, chlorination of waste water is the predominant treatment method, and laws require chlorine residuals in treated waters. An amendment, proposed in August 1975, would delete coliform bacteria limitations and instead require EPA to determine disinfection according to water quality standards. An important chlorine alternative is ozonation. Possibilities for converting chlorination treatment facilities are discussed. In the United States, an ozone treatment project has been operating since 1971 at Blue Plains, near Washington, D.C. Estes Park, Colorado and Cleveland, Ohio, have also adopted ozonation.

*Waste water treatment, *Treatment facilities, *Water purification, *Disinfection, Viruses, Coliforms, Chlorination, Water quality standards, Ozone

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D184

OZONE PROVIDES ALTERNATIVE FOR SECONDARY EFFLUENT DISINFECTION PART 3,

Nebel, C., Gottschling, R. D., Unangst, P. C., O'Neill, H. J., and Zintel, G. V.

Welsbach Ozone Systems Corporation,
Philadelphia, Pennsylvania.

Water and Sewage Works, Vol. 123, No. 6, p 81-83, June, 1976. 4 fig, 41 ref.

The conclusion of a three-part article on ozone in secondary effluent disinfection deals with ozone as a serious alternative to chlorine. At the Blue Plains Treatment plant in Washington, D.C., it has been demonstrated that ozonolysis always shifts the pH toward neutrality. Ozone has also been shown to oxidize all naturally occurring cyanides in a secondary effluent and to eliminate ABS and LAS detergents. Ozone also reduces or eliminates organic pesticides from sewage effluent. It was concluded that ozonization of secondary effluent is an effective disinfection method, with tertiary treatment obtainable at no extra cost. Additionally, an ozone-induced frothing process is capable of removing significant amounts of dissolved and suspended matter via oxidation and physical separation by flotation.

*Waste water treatment, *Sewage treatment, *Ozone, *Sewage effluents, *Disinfection, Chlorine, Hydrogen ion concentration, Oxidation, Detergents, Organic compounds, Tertiary treatment

D185
EQUIPMENT APPLICATIONS IN WASTEWATER TREATMENT CLARIFIERS,

Lodholz, J. C., and Pentz, H.

Public Works, Vol. 107, No. 6, p 97-100, June, 1976. 4 fig.

Gravity separation in primary and secondary clarifiers is generally confined to settling tanks except where industrial wastes susceptible to flotation are present. The chain and flight collector, most commonly used in primary clarifiers, consists of two strands of chain carrying flights at about 10 ft intervals and removes both sludge and scum. Rectangular basins may also be equipped with a travelling bridge, which traverses the length of the basin and carries a scraper blade along the bottom to collect sludge and, on the return run, along the surface for skimming. Collection mechanisms for circular tanks have rotating skimming blades for scum and rotating scraper blades for sludge. Primary sludge collectors with skimmers also require discharge devices, which may be operated manually or automatically, periodically or continuously. A stirring mechanism is required if flocculants are used; separate chambers or the same chamber may be used for mixing and flocculation. Tube settlers are used in advanced waste treatment; sludge normally leaves them by gravity. The frequency of sludge withdrawal and scum removal vary for different plants, but a schedule can be established for a particular plant. Mechanical parts of skimmers and sludge collectors should be checked regularly to determine whether maintenance is required.

*Waste water treatment, *Treatment facilities, *Mechanical equipment, *Separation techniques, *Settling basins, Flotation, Sludge, Scum

*Clarifiers

D186
LAND TREATMENT OF MUNICIPAL WASTEWATER,

Crites, R. W., and Pound, C. E.

Metcalf and Eddy, Incorporated,
Palo Alto, California.

Environmental Science and Technology, Vol. 10, No. 6, p 548-551, June, 1976.
1 fig, 2 tab, 6 ref.

Land treatment and advanced treatment of waste water are economically competitive in many cases and produce effluents of generally comparable quality. The three major types of land treatment, slow-rate, rapid infiltration, and overland flow, are compared. Land treatment removes organics, nitrogen, and some phosphorus, but exchangeable cations and trace elements can cause problems in some soils. In certain cases, municipal waste water should be treated before land application. For a given type of land treatment, the quality of the effluent that can be attained is nearly the same whether untreated, primary, or secondary waste water is applied. Bakersfield, California; Tallahassee, Florida; and San Angelo, Texas all use slow-rate land application to irrigate cropland. Rapid infiltration of waste water that has received secondary treatment is used in Lake George, New York, and Phoenix, Arizona. Overland flow of treated waste water is used in Ada, Oklahoma, and Melbourne, Australia. The costs of land treatment can compare favorably with those of conventional treatment and discharge systems. With proper management and monitoring, land treatment can compete with advanced waste water treatment in many locations in terms of renovated water quality and water and nutrient resource management.

*Waste water treatment, *Treatment facilities, *Land use, *Effluents, Tertiary treatment, Costs, Infiltration rates, Soils, Irrigation, Water quality, Water management (applied)

*Rapid infiltration, *Overland flow

D187

CONTEMPORARY CHLORINE DISINFECTION PRACTICES IN ONTARIO,

Kretch, C. J. H.

Knox Martin Kretch Limited,
Bramalea, Ontario, Canada.

In: Annual Conference Proceedings of the Ontario Section of the American Water Works Association, Pollution Control Association of Ontario, and Ontario Municipal Water Association, April 20-23, 1975, Toronto, Ontario, p 179-198. 2 fig, 6 ref.

Methods for the disinfection of potable water supply sources obtained from both surface and subsurface supplies are discussed, with particular emphasis on chlorine disinfection practices in Ontario, Canada. The following disinfection practices are reviewed: plain chlorination, free residual chlorination, free residual chlorination followed by dechlorination, and chloramination. In general, only plain chlorination is employed for disinfection of potable water supplies throughout Ontario, although Toronto is using free residual chlorination followed by dechlorination at its older plants and free residual chlorination and dechlorination followed by ammoniation at recently constructed facilities. Recently, a trend has been initiated for the adoption of compulsory free residual chlorination at all installations throughout Ontario.

*Disinfection, *Potable water, *Chlorination, *Water purification, Water treatment, Treatment facilities, Groundwater, Surface waters, Water supply

Free residual chlorination, *Dechlorination, Ammoniation, Chloramination

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D188

AUTOMATED FLUORIDATION USING A SELECTIVE ION ELECTRODE,

Manley, W.

Peterborough Utilities Commission,
Peterborough, Ontario, Canada,
Filtration Plant.

In: Annual Conference Proceedings of the Ontario Section of the American Water Works Association, Pollution Control Association of Ontario, and Ontario Municipal Water Association, April 20-23, 1975, Toronto, Ontario, p 200-209, 2 fig, 5 ref.

The use of selective ion electrode systems for monitoring fluoride ion concentrations and controlling the fluoride residual in drinking water supplies is discussed. Unlike colorimetric methods of fluoride measurement, very few physical or chemical interferences occur with the fluoride selective ion electrode. There is no need to dechlorinate or remove the turbidity or color from the sample being measured, and no time-consuming distillation is required. Hydroxide interference can be eliminated by the use of total ionic strength buffers which also provide a high ionic strength background, thereby swamping out variations in sample ionic strength. A continuous analysis and control system for maintaining the proper fluoride residual is outlined. The system utilizes a selective ion electrode in combination with a duplex pump whose stroke length varies in accordance with signals received from the analyzer so that the desired fluoride residual is maintained.

*Fluoridation, *Potable water, *Analytical techniques, *Monitoring, *Fluorides, *Electrodes, Automatic control, Equipment, Automation, Water treatment, Pumps, Treatment facilities

Selective ion electrodes

D189

PRE-TREATMENT OF WATER SUPPLIES UTILIZING FERRIC CHLORIDE,

Carnduff, J. A.

Westerly Filtration Plant,
Toronto, Ontario, Canada,
Quality Control Office.

In: Annual Conference Proceedings of the Ontario Section of the American Water Works Association, Pollution Control Association of Ontario, and Ontario Municipal Water Association, April 20-23, 1975, Toronto, Ontario, p 211-227. 9 tab, 7 ref.

Laboratory, pilot plant, and field tests were conducted to determine the feasibility of using ferric chloride as a substitute coagulant for alum during water treatment operations. The chemical reactions of coagulation in which iron salts react with water to form floc are similar to those of aluminum sulfate, with the main reaction in both instances being between the metal salt and the natural alkalinity in the water to produce complex hydrous oxide compounds. Pilot plant studies established that ferric chloride can be applied in dosages up to 10 ppm in high rate filters operating at rates up to 4 grams/min/sq ft. Tests at a water treatment plant using 1 ppm of ferric chloride showed satisfactory results; increasing the dosage up to 6 ppm only decreased the filter run length while maintaining the same quality of filtered water. The iron in the filtrate was usually less than 0.015 ppm, with only one run exceeding 0.050 ppm. The dosage of ferric chloride required to produce results comparable to those obtained with alum was generally half that for alum addition. A comparison of the costs of ferric chloride versus alum reveals that significant savings can be realized by using ferric chloride as a substitute coagulant.

*Coagulation, *Water purification, *Iron compounds, *On-site investigations, Feasibility studies, Chemical reactions, Water treatment, Performance, Evaluation, Costs, Economics

Ferric chloride, Alum, Aluminum sulfate, Coagulants

D190

A NEW CONCEPT IN SMALL WATER SYSTEMS,

Aldworth, G. A.

James F. MacLaren Limited,
Toronto, Ontario, Canada.

In: Annual Conference Proceedings of the Ontario Section of the American Water Works Association, Pollution Control Association of Ontario, and Ontario Municipal Water Association, April 20-23, 1975, Toronto, Ontario, p 228-248. 12 fig, 1 tab.

Design criteria associated with the development of special water supply and sewage treatment systems subject to geographical and climatic constraints are outlined. Three particular projects are described: the development of an air-transportable above-ground water and sewage treatment system suitable for ambient temperatures between -25 and +125 F, the upgrading of existing water supply systems in Northern Newfoundland and Southern Labrador to render them less susceptible to freeze-up, and the development of a full-scale shallow-buried water and sewage system in very rocky terrain. Detailed information on special equipment used (plastic piping, water heaters, pipe insulation, pipe frost covers, bleeders, mobile fire pumps) and the costs involved is provided along with diagrams of each installation.

*Water supply, *Sewage treatment, *Design criteria, *Topography, *Climates, *Freezing, Waste water treatment, Treatment facilities, Equipment, Materials, Insulation, Costs, Water treatment, Temperature

D191
MAINTENANCE MANAGEMENT OF WATERWORKS SYSTEM,

Smith, J. L.

Thorne Riddell Associates Limited,
Toronto, Ontario, Canada.

In: Annual Conference Proceedings of the Ontario Section of the American Water Works Association, Pollution Control Association of Ontario, and Ontario Municipal Water Association, April 20-23, 1975, Toronto, Ontario, p 249-253. 1 fig.

A system of maintenance management for water works is outlined. The system is designed so that a budget developed will be based not solely on historical data but also on the requirements and capabilities as provided by the level of service and productivity. Basic information required before a work plan and budget can be achieved includes: an inventory of the facilities to be maintained, desired performance standards, the required level of service, and reporting procedures for establishing productivity standards. Financial data can then be added to the above information to develop unit costs (for example, cost per mile of pipe repaired). Benefits gained by establishing a maintenance management program for water works include: the provision of a standard level of service to all people being served by the system, the establishment of an annual work schedule to take into account predicted peaks and lows in work load, and the avoidance of duplication by planning and allocating work in advance.

*Water treatment, *Water works, *Maintenance, *Planning, *Budgeting, *Management, Treatment facilities, Repairing, Maintenance costs, Equipment, Costs

D192
METROPOLITAN TORONTO'S APPROACH TO PREVENTATIVE MAINTENANCE FOR TREATMENT PLANTS,

Baldock, E. H.

Metropolitan Toronto Department of Works,
Toronto, Ontario, Canada,
Water and Pollution Control Directorate.

In: Annual Conference Proceedings of the Ontario Section of the American Water Works Association, Pollution Control Association of Ontario, and Ontario Municipal Water Association, April 20-23, 1975, Toronto, Ontario, p 332-346. 8 fig. 1 tab.

A pilot-scale, computerized equipment maintenance and inventory system being used at water treatment plants in metropolitan Toronto is described. Each piece of equipment being maintained is numbered so that data on its condition can be stored in a computer. The data stored include a cost inventory of all units, a preventative maintenance schedule of all components of the equipment, and a history of the maintenance work which includes the man hours of work performed. The maintenance cycle is a function of the operating hours of each piece of equipment, and this information is fed into the computer on a regular basis. The computer prints out on a weekly basis a list of components to be serviced that week. Upon completion of the task, the workman then records the updated condition of the repaired equipment. Formats used for recording the above data are illustrated.

*Maintenance, *Treatment facilities, *Water treatment, *Computer programs, *Equipment, Repairing, Instrumentation, Canada, Costs

Inventories, Toronto

D193

THE TREATMENT OF WATER PURIFICATION PLANT WASTES,

Simmons, R. A. G., and Bowers, A. J.

Gore and Storrie Limited,
Toronto, Ontario, Canada.

In: Annual Conference Proceedings of the Ontario Section of the American Water Works Association, Pollution Control Association of Ontario, and Ontario Municipal Water Association, April 20-23, 1975, Toronto, Ontario, p 404-429. 6 fig, 1 tab, 5 ref.

Various methods for the treatment and disposal of water purification plant wastes are reviewed. Topics covered include: waste reduction by reducing water usage or implementing process changes; waste collection and centralization; and treatment and disposal options such as barging to sea, lagooning, sand bed drying, discharge to sanitary sewers, freezing, vacuum filtration, centrifuging, filter pressing, and coagulant recovery. Pressure filtration, lagooning, and disposal to sewerage systems are cited as the most probable solutions to waste problems resulting from water purification activities. Alternative final disposal sites are also discussed and include: sanitary landfill sites, specially selected non-agricultural sites, and agricultural land. A cost analysis of alternative waste treatment and disposal processes is presented.

*Water purification, *Waste treatment, *Waste disposal, *Cost analysis, *Land use, Landfills, Sewerage, Filtration, Freezing, Lagoons, Drying, Byproducts, Recycling, Centrifugation

Water treatment wastes

D194

SYMBIOSIS MAKES COMPLETE WATER REUSE PRACTICAL,

Cecil, L. K.

In: 3rd National Conference on Complete WateReuse, June 27-30, 1976, Cincinnati, Ohio, p 12-14.

The establishment of a symbiotic relationship between municipal, industrial, and agricultural activities in an area is proposed as a means to achieve complete water reuse. Sewage and surface runoff from a city can be utilized by industries which are properly situated adjacent the city for heat dissipation requirements. Garbage can be fractionated into burnable compounds for the production of heat energy, with the unburnable fractions being converted into marketable forms. Industries can also utilize agricultural wastes for beneficial purposes if farms are properly located around a city. Waste water from industry, in turn, can be utilized by agriculture if farms are located within a resonable distance of industrial complexes. Thus, by proper collaboration of cities, industries, and farms, the goal of zero discharge of pollutants into the aqueous environment can be approached.

*Water reuse, *Recycling, *Municipal wastes, *Farm wastes, *Industrial wastes, Byproducts, Planning, Pollutants, Sewage, Urban runoff, Waste water

Municipal-industrial wastes

D195

PUERTO RICO: ALONG THE ROUTE OF WATER REUSE,

Irizarry, M. M.

U.S. Environmental Protection Agency,
San Juan, Puerto Rico.

In: 3rd National Conference on Complete WateReuse, June 27-30, 1976, Cincinnati, Ohio, p 46-52. 8 fig, 2 tab, 8 ref.

Activities concerning the reuse of waste water in Puerto Rico are reviewed. The Ponce Regional Water Resources Management Study, which is a cooperative effort between the Puerto Rican government and the U. S. Army Corps of Engineers, is concentrating on waste water management, water supply management, flood control, conservation of fish and wildlife, and recreation, with emphasis being given to water supply. The study covers 14 municipalities over an area of 734 sq mi and is evaluating the following reuse alternatives: the use of secondary treated effluent from water treatment plants for irrigation, infiltration, and percolation; the use of waste water for industrial purposes; and the use of waste water to prevent salt water intrusion. The Corps of Engineers is also conducting an island-wide water supply study with the Puerto Rico Department of Natural Resources. The U. S. Geological Survey has initiated a research project in Fort Allen, Salinas, Puerto Rico dealing with the use of secondary effluent for groundwater recharge.

*Water reuse, *Recycling, *Puerto Rico, *Water supply, *Water management (applied), Irrigation, Infiltration, Percolation, Saline water intrusion, Industrial water, Groundwater recharge, Research and development, Programs, Organizations

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D196

REMOVAL AND RECOVERY OF AMMONIA FROM ANAEROBIC DIGESTER SUPERNATANT,

Prettyman, R. W., and Kepple, L. G.

CH2M Hill,
Redding, California.

In: 3rd National Conference on Complete WateRuse, June 27-30, 1976, Cincinnati, Ohio, p 95-99. 7 fig, 2 tab, 3 ref.

An ammonia removal and recovery process for rendering anaerobic digester supernatant suitable for industrial reuse is described. The supernatant is first aerated to strip excess carbon dioxide so that lime requirements are kept minimal. Lime is then added to precipitate phosphorus, flocculate organic matter, and obtain a pH of 11 for stripping ammonia nitrogen. The ammonia removal and recovery process employs an ammonia stripping unit and an ammonia absorption unit and produces ammonia in the form of a common fertilizer such as ammonium sulfate which can be sold as byproduct. In the stripping unit, the high pH influent stream flows down over packing material, and the recirculating air stream passes upward and carries the ammonia gas-laden air to the absorption unit. The stripping unit effluent which is relatively low in ammonia nitrogen is discharged from the bottom of the unit. Ammonia-laden air contacts an acidic absorbent liquid in the absorber unit, with ammonia gas being dissolved in the absorbent liquid and converted to ammonium ions. If sulfuric acid is added, for example, an ammonium sulfate solution is formed.

*Waste water treatment, *Byproducts, *Anaerobic digestion, *Ammonia, Fertilizers, Water reuse, Recycling, Water reclamation, Effluents, Industrial water, Nitrogen, Phosphorus, Absorption, Aeration, Flocculation, Chemical precipitation, Organic acids, Sulfates

Stripping

D197
UNION CARBIDE'S REUSE OF SEWAGE WATER,

Banerji, R. N.

Carbide Chemicals Company,
Bombay, India.

In: 3rd National Conference on Complete WateReuse, June 27-30, 1976, Cincinnati, Ohio, p 161-165. 1 fig, 4 tab.

A system for processing municipal sewage water and reusing it for industrial operations at Union Carbide's Chemicals and Plastics plant at Bombay, India is described. The sewage treatment system involves: raw water pumping and conveying, detritus matter removal, biological treatment (activated sludge) with extended aeration, clarification, chemical dosing, flocculation, sand filtration, softening, post chlorination, and demineralization. In order to make the treated water fit for industrial use and comparable with water from the municipal mains, the filtered water is passed through a softening process where the hardness is reduced from 140 milligram/liter to about 40 milligram/liter. The cost of the sewage reclaimed water is $.43/1000 imperial gallons as compared with $.72/1000 imperial gallons of municipal water.

*Sewage treatment, *Water reuse, *Water reclamation, *Symbiosis, *Industrial water, Biological treatment, Activated sludge, Aeration, Flocculation, Filtration, Water softening, Chlorination, Costs, Demineralization, Sewage, Waste water treatment

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D198
GRANULAR MEDIA FILTRATION: A POSITIVE COST EFFECTIVE METHOD TO PREPARE WASTEWATERS FOR REUSE BY REMOVAL OF SUSPENDED SOLIDS,

Mace, G. R.

Ecodyne Corporation,
Union, New Jersey,
Industrial Waste Treatment Division.

In: 3rd National Conference on Complete WateReuse, June 27-30, 1976, Cincinnati, Ohio, p 185-190. 7 fig, 2 tab.

The use of granular media filtration for removing suspended solids from waste waters which are intended for reuse has recently increased. Filters can effectively remove up to 200-250 ppm of suspended solids from waste waters and produce effluent clarities in the 1-15 ppm suspended solids range. Granular filters are also the only time-tested unit operation available for filtering volumes of waste water experienced in industrial waste treatment plants. Types of granular filter configurations available include: vertical gravity, deep media vertical gravity or pressure, horizontal ('hot dog'), concrete gravity, and upflow gravity or pressure types. A combination of air scouring, underdrain nozzles, and air metering tubes not only allows for the removal of suspended solids in the 200-250 ppm range but allows for the removal of up to 60 ppm of oil. Backwashing which is initiated by turbidity meters in addition to pressure differential and automatic timers is being employed to achieve the consistently low suspended solids levels required for recycling and discharge.

*Filtration, *Filters, *Granules, *Waste water treatment, Suspended solids, Water reuse, Water reclamation, Recycling, Oil, Efficiencies, Performance, Equipment

Backwashing

D199
WASTEWATER RECYCLE - THE PROPER APPROACH TO EVALUATION OF DISPOSAL VERSUS REUSE,

Mace, G. R.

Ecodyne Corporation,
Union, New Jersey,
Industrial Waste Treatment Division.

In: 3rd National Conference on Complete WateReuse, June 27-30, 1976, Cincinnati, Ohio, p 191-195. 2 fig, 6 tab.

A procedure for evaluating the cost of industrial waste water disposal versus recycle is presented. The procedure can be broken down into four major steps: a detailed analysis of the effluent, the effect of recycle water on the quality of the product, an analysis of waste treatment operations available, and the total economic analysis. The disposal of sludge is an especially important consideration since it is the most expensive part of the treatment system. The cost of sophisticated equipment to recover waste products should be weighed against direct disposal via landfill. The total economic analysis can be broken down into three independent analyses that need to be constructed: economic selection of individual waste treatment unit operations, economic selection of dewatering and sludge disposal alternatives, and the final economic decision of recycle versus disposal. A hypothetical case study is presented to illustrate the procedure.

*Water reuse, *Water reclamation, *Waste water disposal, *Waste water treatment, *Industrial water, *Cost comparisons, *Cost analysis, Sludge disposal, Dewatering, Byproducts, Waste treatment, Economics, Water supply, Evaluation, Analytical methods

D200
THE EFFECTIVENESS OF GRANULAR ACTIVATED CARBON IN TREATING MUNICIPAL AND INDUSTRIAL WASTEWATERS,

DeJohn, P. B.

ICI United States, Incorporated,
Wilmington, Delaware.

In: 3rd National Conference on Complete WateReuse, June 27-30, 1976, Cincinnati, Ohio, p 204-211. 3 fig, 7 tab, 20 ref.

The use of granular activated carbon adsorption for treating municipal and industrial waste waters is discussed. Topics covered include: methods for evaluating activated carbon, adsorption data developed on municipal wastes, the comparative physical properties of lignite and bituminous coal carbons, adsorption data developed on various types of industrial wastes, the effect of thermal regeneration on the adsorption performance of carbon, and symbiotic processes involving the utilization of carbon fines in other waste water processes and the utilization of the heat content of exit gases from other plant processes to regenerate activated carbon. Virgin bituminous coal carbons perform better than virgin lignite carbons in waste streams containing predominantly small molecules and vice versa. If the waste stream contains mostly small molecules, the granular carbon system should be designed on the basis of the performance of regenerated carbon. Isotherms can be used to determine if carbon can reduce the impurity level to the desired quantity.

*Adsorption, *Activated carbon, *Waste water treatment, *Granules, Municipal wastes, Industrial wastes, Physical properties, Coals, Performance, Isotherms, Measurement

D201

SALA-HGMS MAGNETIC FILTERS FOR THE TREATMENT OF COMBINED SEWER OVERFLOW,

Allen, D., Arvidson, B., Oberteuffer, J., and
Sargent, R.

Sala Magnetics, Incorporated,
Cambridge, Massachusetts.

In: 3rd National Conference on Complete WateReuse, June 27-30, 1976, Cincinnati, Ohio, p 239-251. 8 fig, 12 tab, 19 ref.

Bench test and preliminary pilot plant results are presented for the treatment of combined storm overflow and raw sewage with high gradient magnetic separation filters. Good performance was obtained with a flocculation train residence and filtration time of 3 minutes or less, a fraction of the time required for flocculation and processing in conventional waste treatment systems. Although the flocs formed were very small in size compared with those necessary for conventional settling or filtering, the flocs themselves were much less susceptible to physical disruption. There were also indications that the addition of a magnetic filter aid such as magnetite can reduce chemical reaction time to less than 90 seconds. Pilot plant tests on combined sewage overflow revealed cycle to cycle variations in performance not exceeding 2%, indicating the system's stability. The data also indicated that the results obtained with seeded high gradient magnetic filtration generally surpass those obtained with primary and secondary stages of conventional treatment in a single treatment stage. Typical data are presented for suspended solids, biochemical oxygen demand, chemical oxygen demand, turbidity, heavy metals, and bacterial counts.

*Filters, *Magnetic studies, *Waste water treatment, *Filtration, Sewage, Storm water, Flocculation, Chemical reactions, Performance, Suspended solids, Heavy metals, Bacteria, Biochemical oxygen demand, Chemical oxygen demand, Turbidity, Pilot plants, Separation techniques

Magnetic separation filters

D202

THICKENING OF SEWAGE SLUDGE WITH QUATERNARY AMMONIUM COMPOUNDS AND MAGNETIC FIELDS,

Wang, L. K., Wang, M. H., Ziegler, R. C., and Strier, M. P.

Calspan Corporation,
Buffalo, New York.

In: 3rd National Conference on Complete WateReuse, June 27-30, 1976, Cincinnati, Ohio, p 252-258. 2 fig, 3 tab, 17 ref.

A process using quaternary ammonium compounds and magnetic fields for the thickening of sewage sludge was evaluated. Sludge dewatering experiments were performed by adding finely divided iron oxide particles which acted as both weighting and polarization-inducing agents along with quaternary ammonium compounds which acted as both flocculating and disinfectant agents. The agglomerates (or flocs) containing the sludge solids, iron oxide, and quaternary ammonium compound were flocculated and then passed through a magnetic field for further polarization. The polarized iron ores associated with the sludge agglomerate attracted each other to form very high weight-to-surface area floc particles; and the condensed flocs, with or without treatment by secondary flocculation, then settled rapidly. The supernatant and settled sludge were simultaneously disinfected by the quaternary ammonium compound. The use of the quaternary ammonium compound resulted in better sludge thickening than that obtained from a control experiment and also resulted in a drop in total coliform count in the supernatant from more than 100,000,000/100 ml to about 160/100 ml. The application of the magnetic field proved beneficial to the sludge thickening process when the system contained iron oxide particles.

*Sludge treatment, *Dewatering, *Ammonium compounds, *Magnetic studies, *Disinfection, Coliforms, Iron oxides, Flocculation, Evaluation, Performance, Waste treatment, Sludge, Bacteria

D203

REVERSE OSMOSIS PILOT PLANT STUDIES FOR THE PURIFICATION AND REUSE OF EFFLUENT FROM A SANITARY WASTE TREATMENT PLANT,

Plock, C. E., Hausburg, D. E., and Horrell, D. R.

Rockwell International,
Golden, Colorado,
Rocky Flats Plant.

In: 3rd National Conference on Complete WateReuse, June 27-30, 1976, Cincinnati, Ohio, p 268-273. 4 fig, 5 tab.

Pilot plant studies on the use of reverse osmosis to treat sanitary waste treatment effluent for reuse at a nuclear weapons facility were conducted. After passing about 20 gallons/minute of treated sanitary effluent through a pre-treatment stage, a chemical treatment stage, and a final filter, a reverse osmosis unit using cellulose triacetate hollow fiber membranes was employed to produce about 17.5 gallons/minute of product water and 2.2 gallons/minute of brine for a water recovery of 89%. Cellulose triacetate membranes were selected over polyamide hollow fiber membranes because of the following advantages: lower operating pressures, high rejection rates, higher quality product water, higher water recovery, lower inorganic scaling, the absence of bacterial fouling, and less susceptibility to temperature change. The pilot plant studies indicate that a product water containing less than 100 mg/liter of total dissolved solids can be obtained and that the flow of brine to the process waste treatment evaporator will be no greater than 2% of the feed stream going to the reverse osmosis recycling plant.

*Reverse osmosis, *Waste water treatment, *Water reuse, *Reclaimed water, Sanitary engineering, Treatment facilities, Equipment, Reclamation, Dissolved solids, Pilot plants, Performance

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D204

RECLAMATION OF GAS TURBINE WASTE HEAT FOR SLUDGE DRYING,

Ernest, L. A., Birner, R. E., Schlintz, J. H., and
Manthe, R. M.

Metropolitan Sewerage District of the
County of Milwaukee,
Milwaukee, Wisconsin.

In: 3rd National Conference on Complete WateReuse, June 27-30, 1976, Cincinnati, Ohio, p 361-369. 2 fig, 2 tab, 1 ref.

The recovery of gas turbine waste heat for sludge drying at an activated sludge waste water treatment plant is described. Waste heat from gas turbines in the power generation section of the waste water treatment plant is diverted to 10 dryer furnaces to provide a drying temperature of 1200 F. This combined cycle operation reduces dryer fuel requirements by 70% and overall actual fuel consumption by 20%. The system is inherently safe because the dryers are normally at a negative pressure condition and consequently impose no detrimental back pressure on the gas turbine or connecting duct work. In addition, pressure sensitive devices dump the exhaust gases in the event of excessive back pressure to protect the system.

*Sludge treatment, *Drying, *Heat transfer, *Symbiosis, *Byproducts, Treatment facilities, Equipment, Powerplants, Efficiencies, Temperature, Activated sludge, Waste water treatment

Combined cycles

D205

WASTEWATER REUSE WITHIN AN ARMY FIELD HOSPITAL,

Lambert, W. P., and Reuter, L. H.

U. S. Army Medical Bioengineering
Research and Development Laboratory,
Fort Detrick, Maryland.

In: 3rd National Conference on Complete WateReuse, June 27-30, 1976, Cincinnati, Ohio, p 447-456. 4 tab, 41 ref.

A waste water reuse scheme proposed for transportable army field hospitals is described. The waste water reclamation and recycling system is designed to help meet water supply needs, to reduce logistical requirements, and to maintain necessary tactical flexibility. The system has two principal operating modes and three primary functions. An integrated mode functions to treat nonsanitary waste streams for nonpotable reuse; operation requires 85% net influent water recovery at approximately 4200 gallons/day outflow. The purified water will be used for potable use eventually. The second mode of operation has two functions. Nonsanitary waste waters from the hospital are treated for discharge to the environment by one set of unit processes, while a water purification unit treats natural fresh or brackish waters for potable use. The second operation mode involves the production of at least 3900 gallons/day of treated waste water, with at least 94% of the influent being discharged. The water purification unit produces at least 3500 gallons/day of potable water with no more than 10% influent loss.

*Water reuse, *Reclaimed water, *Waste water treatment, *Hospitals, Potable water, Treatment facilities, Equipment, Efficiencies, Water purification, Brackish water, Freshwater

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D206

TREATMENT OF ARMY MUST FIELD HOSPITAL WASTEWATER FOR WATER REUSE,

Gollan, A. Z., Kleper, M. H., McNulty, K. J., and
Goldsmith, R. L.

Walden Research,
Cambridge, Massachusetts.

In: 3rd National Conference on Complete WateReuse, June 27-30, 1976, Cincinnati, Ohio, p 462-475. 11 fig, 7 tab, 5 ref.

A 1/4-scale breadboard version of a waste water treatment system designed for transportable Army hospitals was tested. The system is designed for operation in water reuse, water desalting, and waste treatment/discharge modes. The test demonstrated that the selected sequence of unit processes (waste equalization, ultrafiltration, reverse osmosis, ozonation, and chlorination) was effective in treating a time-varying composite of individual hospital wastes. The ultrafiltration and reverse osmosis stages were highly effective in reducing the total solids and organics concentrations of the equalized waste. Overall removal efficiencies for the ultrafiltration/reverse osmosis section ranged from 88-92% for total solids, 91-93% for total organic carbon, and 92-97% for chemical oxygen demand. Rather poor removal efficiencies were obtained for the ozonation system tested. The poor performance of the ozonation system was a result of reactor design and operation, the low output of the ozone generator, the presence of a refractory organic residual in the reverse osmosis permeate, and the lack of an automatic feedback system to control ozone conversion. The average overall system water recovery for the water reuse mode was 87%.

*Waste water treatment, *Desclination, *Water reuse, *Reclaimed water, *Hospitals, *Treatment facilities, Reverse osmosis, Filtration, Ozone, Chlorination, Organic compounds, Water purification, Carbon, Chemical oxygen demand, Solid wastes, Performance, Evaluation, Efficiencies, Equipment

D207
THE REMOVAL OF METALS FROM WASTEWATERS BY CHEMICAL TREATMENT AND FILTRATION,

Petrasek, A. C., Jr., and Esmond, S. E.

Texas A & M University,
Dallas,
Dallas Water Reclamation Research Center.

In: 3rd National Conference on Complete WateReuse, June 27-30, 1976, Cincinnati, Ohio, p 502-509. 6 fig, 14 tab.

The use of various chemical treatment methods along with filtration for the removal of metals from waste waters was investigated. Waste water from a sewage treatment plant was given additional biological treatment in a completely mixed activated sludge system, was chemically coagulated and filtered, and passed through an activated carbon contactor. For the chemical treatment stage, three different approaches were investigated: high pH lime coagulation, alum coagulation, and high pH lime coagulation and recarbonation. High pH lime coagulation and recarbonation was generally more effective in removing metals than was alum coagulation. This was especially true for toxic metals such as arsenic, cadmium, chromium, mercury and lead. Detailed removal percentages and changes in mean metals concentrations are reported for 25 metals.

*Waste water treatment, *Metals, *Coagulation, *Filtration, Sewage, Lime, Arsenic compounds, Cadmium, Chromium, Mercury, Lead, Efficiencies, Performance, Evaluation, Biological treatment

Chemical treatment, Recarbonation, Alum

D208
WATER REUSE RESEARCH,

Petrasek, A. C., Jr., and Rice, I. M.

Dallas Water Reclamation Research Center
and Engineering,
Dallas, Texas.

In: 3rd National Conference on Complete WateReuse, June 27-30, 1976, Cincinnati, Ohio, p 556-566. 11 fig, 13 tab, 5 ref.

Various waste water treatment sequences were evaluated as part of a research program for developing water reuse systems. The treatment sequences evaluated consisted of the following unit processes operating in series, with the most significant difference being the type of chemical treatment utilized in the sequence: biological treatment with completely mixed activated sludge; chemical coagulation, flocculation, and clarification; multi-media filtration; and activated carbon adsorption. A chemical treatment sequence employing high pH lime coagulation and recarbonation appeared to result in the best metals removals. High pH lime coagulation was also very effective for removing indicators (coliforms) of pathogenic bacteria. Low chemical oxygen demand and soluble total organic carbon concentrations were obtained with all of the treatment processes investigated. Nitrogen removal was not a problem because of uncontrolled denitrification in the final clarifier on the activated sludge system. However, nitrate nitrogen concentrations did closely approach the 10 mg/liter standard, and the addition of an anion exchange system capable of processing about 25% of the total product water appears desirable.

*Waste water treatment, *Metals, *Coliforms, *Coagulation, Biological treatment, Activated sludge, Flocculation, Filtration, Adsorption, Chemical oxygen demand, Carbon, Organic compounds, Nitrogen, Nitrates, Ion exchange, Microorganisms, Water reuse, Lime, Evaluation, Performance, Treatment facilities, Denitrification

D209
WATER FACTORY 21,

Argo, D. G.

Orange County Water District,
Fountain Valley, California.

In: 3rd National Conference on Complete WateReuse, June 27-30, 1976, Cincinnati, Ohio, p 567-577. 16 fig, 3 tab, 5 ref.

The design and start-up of a full-scale advanced design waste water reclamation plant that is part of the Orange County California Water Factory 21 are described. The waste water reclamation plant is designed to treat 15 mgd of trickling filtered secondary effluent. The plant processes include: lime coagulation, ammonia stripping, two-stage recarbonation, mixed-media filtration, activated carbon adsorption, chlorination, and blending. During the initial start-up of the plant, its ability to meet its discharge objectives was demonstrated for all parameters except mineral quality. The plant effectively removed organics, turbidity, heavy metals, bacteria, and viruses. A waste water demineralization plant is being constructed so that the mineral quality objective can be attained. Detailed diagrams are illustrated for each process, and plant effluent data are compared with discharge objectives.

*Waste water treatment, *Reclamation, *Treatment facilities, *On-site tests, *Reclaimed water, *Water reuse, Organic compounds, Viruses, Turbidity, Heavy metals, Bacteria, Coagulation, Lime, Adsorption, Activated carbon, Chlorination, Filtration, Ammonia, Design criteria, Performance

Recarbonation, Ammonia stripping

D210
FLY ASH - A POTENTIAL ASSET IN WASTEWATER TREATMENT,

Gangoli, N., and Thodos, G.

Northwestern University,
Evanston, Illinois.

In: 3rd National Conference on Complete WateReuse, June 27-30, 1976, Cincinnati, Ohio, p 623-628. 4 tab, 29 ref.

Applications which utilize fly ash in waste water treatment operations are reviewed. Fly ash has been used as a filter aid in dewatering sewage sludges, as a coagulant and precipitating agent, and for adsorbing dissolved substances in waste waters. In addition to enhancing the dewatering of activated and digested sludges, fly ash is also effective in removing organics and phosphates. Fly ash has been used as an adsorbent for the recovery of phenol from industrial waste waters and for the removal of alkyl benzene sulfonate, a surfactant used in detergents. Paper mill effluents have been treated with fly ash for the elimination of odor and the removal of chemical oxygen demand. The high alkalinity associated with fly ash makes this substance an excellent treatment aid for the precipitation of heavy metals present in the effluent streams of electroplating and metal finishing industries.

*Fly ash, *Byproducts, *Waste water treatment, *Sludge treatment, Industrial wastes, Chemical oxygen demand, Organic compounds, Heavy metals, Phosphates, Dewatering, Phenol, Alkyl benzene sulfonate, Odor, Surfactants, Adsorption, Coagulation, Chemical precipitation

D211

BIN ACTIVATORS RELIABLY FEED LIME AND DIATOMACEOUS EARTH IN WATER TREATMENT FACILITY,

Pollution Engineering, Vol. 8, No. 6, p 14, 18, June, 1976. 1 fig.

An automated system to feed diatomaceous earth and pebble lime assures that a filter washwater and alum sludge disposal facility installed by Passaic Valley Water Commission (PVWC) at their Little Falls Water Treatment Plant in Totowa, New Jersey, will operate successfully. The new plant eliminates the discharge of 20 tons of sludge a day into the Passaic River and enables PVWC to meet the 1985 Federal zero discharge requirements. The new facility, which utilizes sludge presses, requires uninterrupted flow of diatomaceous earth and lime to the dewatering system from storage bins. Approximately 6500 and 1100 lb of pebble lime and diatomaceous earth, respectively, are fed to the system daily. To eliminate possible flow problems, four Vibra Screw Bin Activators were installed on the storage bins. Lime is discharged to slakers, at the rate of 1000 lb/hr, through 8-in. diameter discharge outlets on three of the activators. The other Bin Activator discharges 400 cu ft/hr of diatomaceous earth to a heavy duty feeder. The Bin Activator is vibrated and replaces a static bin bottom, removing the compaction area where flow problems originate. The feeder is a rugged volumetric screw feeder whose trough and feed screw vibrate. Vibration of the trough maintains uniform density and insures complete filling and emptying of each of the screw's flights. Feeder output is determined by screw speed and is controllable to better than 1% accuracy.

*Treatment facilities, *Water treatment, *Lime, *Diatomaceous earth, *Automation, Sludge disposal, Sludge, Mechanical equipment

*Bin activators

D212

COMPARATIVE EFFECTS OF CHEMICAL PRETREATMENT ON CARBON ADSORPTION,

Westrick, J. J., and Cohen, J. M.

Environmental Protection Agency,
Cincinnati, Ohio,
Municipal Environmental Research Laboratory.

Journal Water Pollution Control Federation, Vol. 48, No. 2, p 323-338, February, 1976. 18 fig, 4 tab, 18 ref.

Three physico-chemical pilot plants were operated for a period of nearly 11 mo with three distinctly different chemical clarification schemes preceding identical granular activated carbon and filtration systems. All produced effluents with low concentrations of phosphorus, organics, and solids. A data analysis method was developed that permits simplistically comparing carbon dosages required for given effluent qualities. Superior organic removal was provided by the iron coagulant in clarification-filtration pretreatment, yielding the lowest estimated cost for a carbon system to produce any effluent quality studied. These estimates include only the carbon process, with regeneration, and exclude other total system costs. These results obviously are specific to the waste type and conditions of operation. Although small differences in performance were observed for the three systems, all produced effluents in essentially the same range of quality.

*Waste water treatment, *Treatment facilities, *Adsorption, *Activated carbon, Pilot plants, Filtration, Effluents, Phosphorus, Organic matter, Suspended solids

Physico-chemical treatment

D213
THE EXTENSION OF THE SEWAGE-TREATMENT PLANTS OF STUTTGART
(DER AUSBAU DER STUTTGARTER KLAERWERKE),

Haydt, W.

Forum Umwelt Hygiene, Vol. 27, No. 5, p 167-173, 1976. 20 fig.

The catchment area of the city of Stuttgart, Germany, covers 265 sq km. The central sewage treatment works and three smaller treatment plants in the suburbs needed enlargement due to new design criteria, improved storm water treatment, and environmental protection. In all these treatment plants the biological treatment and sludge treatment were improved and enlarged in two sections. Total costs were approximately 50 million DM. In 1978, the effluent biochemical oxygen demand (BOD) should be below 20 mg BOD/liter. Some research investigations are being conducted utilizing tertiary treatment to produce an effluent BOD of 10 mg BOD/liter.

*Waste water treatment, *Sewage treatment, *Biological treatment, *Treatment facilities, *Biochemical oxygen demand, Sewerage, Europe, Sludge treatment

D214
INDUSTRIAL WASTES MEET DOMESTIC SEWAGE,

American City and County, Vol. 91, No. 6, p 71-72, June, 1976. 2 fig, 1 tab.

The construction of a combined secondary treatment plant to handle municipal primary wastes from the city of Grand Rapids, Michigan and industrial wastes from a paper mill is described. The treatment plant is an extended aeration type. Following primary treatment, overflow from the domestic and industrial primary clarifiers is combined and pumped to the secondary plant through a 36-inch force main. Two 'A' lagoons receive the primary effluent and waste activated sludge. These 'A' lagoons operate in a complete-mix mode with a 29-hour detention time and are designed to remove from 55-90% of the influent biochemical oxygen demand. Effluent from the 'A' lagoons goes to two clarifiers where sludge is settled out for return to the lagoons or for pumping to the primary plant for dewatering. Clarifier effluent flows to two 'B' lagoons for further aeration with a 30-hour detention time to complete the biochemical oxygen demand removal. The liquor then flows to two 'C' lagoons for chlorination and final settling prior to discharge to the river. The city owns the facility, and the paper mill pays for service based on a metered flow pro-rated share. Problems being experienced with the facility include odor and foam control which are expected to be solved with additives and minor repairs.

*Waste water treatment, *Industrial wastes, *Municipal wastes, *Aeration, Biological treatment, Oxidation lagoons, Biochemical oxygen demand, Odor, Foaming, Chlorination

D215

LIVING FILTER PERKS UP REGIONAL SYSTEM,

Lappo, R. L.

Keifer and Associates, Incorporated,
Chicago, Illinois,
Western Michigan Office.

Water and Wastes Engineering, Vol. 13, No. 6, p 18-22, 33, 44, June, 1976. 2 fig, 3 tab.

An irrigation system for treating waste water from 13 cities and towns and five major industries in Muskegon County, Michigan is described. Raw waste water is pumped 11 miles through a 66-inch reinforced concrete force main to a waste water treatment facility. The raw sewage is intensively oxygenated for three days by mechanical aeration and then stored in lagoons that function as oxidation and settling ponds. Effluent ready for irrigation is discharged through an outlet lagoon which has a surface area of 14 acres and a working depth of 12 feet. Immediately prior to irrigation, the water passes through a chlorinator for disinfection. Tertiary treatment is obtained by passing the effluent from the lagoon treatment facilities through the aerobic soil zone. The irrigation facilities are designed to apply the annual supply of waste water during a 7-month irrigation season. The daily average influent to the system is 28.5 million gallons/day, with 40% of it being domestic and 60% industrial.

*Irrigation, *Waste water treatment, *Water reuse, *Symbiosis, Domestic wastes, Industrial wastes, Oxidation lagoons, Biological treatment, Aeration, Chlorination, Treatment facilities, Michigan

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D216

MASS TRANSFER LIMITATIONS ON TRICKLING FILTER DESIGN,

Schroeder, E. D., and Tchobanoglous, G.

California University,
Davis,
Department of Civil Engineering.

Journal Water Pollution Control Federation, Vol. 48, No. 4, p 771-775, April, 1976. 4 fig, 5 ref.

The limiting effect of the oxygen transfer rate on trickling filter performance is discussed. There appears to be no real understanding as to what extent oxygen transfer must be limited before problems occur, and it is not possible to obtain more than a rough estimate of the maximum influent organic concentration using available data. In many areas of the country, there are periods, especially during the summer, when essentially no air flow occurs through trickling filters because temperature differentials are negligible; however, detailed reports on the results of no air flow are not documented in the literature. The maximum applied biochemical oxygen demand concentration determined for trickling filters packed with plastic media is estimated at 400 mg/liter and seems to be appropriate for design purposes, although it is probably a conservative figure. When biochemical oxygen demand concentrations in excess of 500-600 mg/liter are applied, the mass transfer rate of oxygen may become limiting. The probability of odor production will also increase under these conditions.

*Mass transfer, *Rates, *Trickling filters, *Oxygen, Performance, Waste water treatment, Biochemical oxygen demand, Design criteria, Odor, Kinetics

Oxygen transfer rate

D217
COLESHILL (2): INCINERATING SEWAGE SLUDGE,

Water, No. 8, p 23-24, May, 1976. 1 fig.

A description of the Severn Trent Water Authority's sewage sludge incineration plant at Coleshill, England is provided. The plant handles sludge from sewage treatment plants in the area which amounts to about 3500 cu m/day. The sludges which contain about 95% water are initially passed through mechanically raked screens for removal of gross solids and are then directed to storage tanks where they can be held, mixed, or transferred. The sludges are next chemically treated to assist dewatering and are stirred and air-agitated to ensure thorough mixing. After conditioning, the sludge is dewatered by pressure to produce a solid sludge cake containing 65% moisture. The sludge cake is incinerated in two of three furnaces which operate at any one time. The liquid produced by dewatering is pre-treated at the incinerator so that it may be processed with normal sewage at the nearby sewage treatment plants.

*Sludge treatment, *Sludge disposal, *Incineration, *Dewatering, *Treatment facilities, Waste treatment, Equipment

D218
COLESHILL (1): EXPERIMENTING WITH WASTE WATER TREATMENT,

Banks, N.

Water, No. 8, p 20-22, May, 1976.

The design of an advanced waste water treatment pilot plant in the United Kingdom which was constructed as a result of a study on advanced waste water treatment methods by the Committee on the Challenges of Modern Society is described. The design involves parallel feed streams of waste water piped along both faces of a fixed gantry and mobile treatment units which may be connected in any order to either feed stream. Units dealing with physico-chemical treatment include: chemical flashmixing and flocculation tanks and multimedia and activated carbon filters. There are also acid/alkaline adjustment facilities and a fixed installation for preparing and dosing chemicals. Mobile units for conventional biological treatment processes include surface aeration tanks and high-rate biological filters. Five pairs of mobile settling tanks and a fixed installation for sludge treatment are common to both the physico-chemical and biological treatment processes. Plant performance is monitored by portable sensors which transmit data to a central data-logging installation.

*Pilot plants, *Treatment facilities, *Tertiary treatment, *Waste water treatment, *Equipment, Biological treatment, Flocculation, Activated carbon, Filtration, Aeration, Settling basins, Monitoring, Instrumentation, Programs, United Kingdom

Physico-chemical treatment

D217
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*Pilot plants, *Treatment facilities, *Tertiary treatment, *Waste water treatment, *Equipment, Biological treatment, Flocculation, Activated carbon, Filtration, Aeration, Settling basins, Monitoring, Instrumentation, Programs, United Kingdom

Physico-chemical treatment

D219

AMMONIA REMOVAL FROM WASTEWATER BY LIGAND EXCHANGE,

Dobbs, R. A., Uchida, S., Smith, L. M., and Cohen, J. M.

Environmental Protection Agency,
Cincinnati, Ohio,
National Environmental Research Center.

Adsorption and Ion Exchange, Vol. 152, No. 71, p 157-163, 1975. 7 fig, 4 tab, 11 ref.

The technical feasibility of removing ammonia from municipal waste water by a ligand exchange process was demonstrated along with the subsequent regeneration of the exhausted exchanger with low pressure steam. An ion exchanger containing hydrous zirconium oxide was converted to the cupric form for removing ammonia by the mechanism of ligand exchange. Copper bleed during loading was less than one microgram/liter of copper. The pH of the waste water being treated was found to be important since undissociated ammonia rather than ammonium ion was the species involved in the reaction; the optimum pH range was between 10 and 11. The common waste water anions, phosphate and sulfate, did not compete with ammonia at concentrations of 10 and 100 milligrams/liter, respectively; and no exchange in ammonia capacity was observed in the presence of these ions. The exhausted exchanger was readily regenerated by steam at a temperature of 135 C. Additional research is needed to establish the process as an alternative for ammonia removal.

*Ion exchange, *Ammonia, *Waste water treatment, *Municipal wastes, Feasibility studies, Evaluation, Performance, Chemical reactions, Phosphates, Sulfates, Alkalinity

Ligand exchange

D220

COMPACT INCINERATOR FOR SOLID AND LIQUID WASTES,

Processing, Vol. 22, No. 5, p 33, May, 1976. 1 fig, 1 tab.

A small, self-contained incinerator known as the 'Furnapak' which incorporates several design features of larger multiple hearth furnaces is available for applications involving the burning of sewage screening, oily wastes, and sewage sludges. The incinerator uses a rotating rabble shaft and air injection in a manner similar to multiple hearth furnaces. Both solid and liquid wastes can be incinerated either simultaneously or independently. Solid waste is loaded manually onto a solid bowl refractory hearth through an air-operated door large enough to accommodate standard refuse sacks. Liquid wastes and pumpable sludge are introduced into the incinerator through a tangentially mounted inlet port. Problems of burner blockage are avoided by the use of a simple weir type burner in which the fuel falling over the weir is atomized by low pressure air from the main combustion air fan. Any mixture of waste oil, oily water, sewage, and other sludges containing solids particles up to 0.5-inches in size can be handled efficiently. The incinerator is capable of feed rates up to 350 kilograms/hour for feeds containing up to 80% moisture.

*Sludge disposal, *Sewage disposal, *Oil wastes, *Incineration, Waste disposal, Equipment, Solid wastes, Liquid wastes, Sludge

D221

SEWAGE UPGRADES PLANT EFFLUENT,

Water and Sewage Works, Vol. 123, No. 6, p 72-73, June, 1976.

The recycling of secondary treatment effluent has significantly improved the efficiency of internal operations at the Metropolitan Denver Sewage Disposal District Number 1 plant near Commerce City, Colorado. A portion of the effluent from the secondary clarifiers is used for several utility functions normally requiring clean tap water. An Adams VWS-16 Automatic Water Strainer is used to remove solids from the secondary treatment effluent prior to recycling. The strainer is equipped with Poroedge tubes with a slot width of 0.010 in and is designed for automatically programmed backwash based on the total pressure drop across the system. During the backwash cycle, the tubes are backwashed sequentially, one tube at a time, and the backwash water is returned to the system input. The recycled water is available at virtually no cost and affords a significant savings over municipal tap water used for the same purpose.

*Recycling, *Sewage treatment, *Treatment facilities, *Costs, *Water reuse, Filtration, Effluents, Solid wastes, Equipment, Efficiencies

D222

SUBMERSIBLE PUMPS UPGRADE SEWAGE HANDLING,

Water and Sewage Works, Vol. 123, No. 6, p 70-71, June, 1976.

The use of submersible pumps in the city of Belleville, Illinois to upgrade sewage handling is discussed. In addition to more efficient waste water handling, submersible pumps also offer the following advantages: only a single wet well is required; only one discharge valve is required for each pump, and no influent valve is required; accessory equipment such as fans, dehumidifiers, ladders, and lights is unnecessary; and maintenance and repair requirements are reduced. The submersible stations being installed in Belleville are all of the duplex type, each equipped with a pair of Flygt electric submersible pumps. Thus far, the installation of submersible pumps has saved about 3 hours each day in maintenance and inspection time. Another advantage of submersible stations is the relative ease of increasing station capacity as dictated by the growth of an area. At one pumping station, for example, the capacity was tripled by simply changing pumps and two components in the control panel; no changes in piping or other modifications were required.

*Pumping plants, *Sewage disposal, *Subsurface flow, *Municipal wastes, Pumps, Equipment, Waste water treatment, Treatment facilities, Efficiencies, Maintenance, Mechanical equipment, Sanitary engineering, Waste water disposal

Submersible pumps

D223

TYPES OF MICRO-ORGANISMS IN ACTIVATED SLUDGE IN DEPENDENCE OF TEMPERATURE AND NITRIFICATION (DIE BESIEDLUNG DES BELEBTEN SCHLAMMES IN ABHAENGIGKEIT VON TEMPERATUR UND NITRIFIKATION),

Frenzel, H-J.

Zeitschrift fuer Wasser- und Abwasser-Forschung, Vol. 9, No. 3, p 71-75, 1976.
10 fig, 12 ref.

Sludge from four activated sludge pilot plants was microscopically examined over a period of several years to test statistically the dependence on nitrification and temperature of 10 protozoa and rotatoria species. Epistylis plicatilis, Arcella vulgaris, and Lecane species strongly depend on nitrification and temperature in all types of treatment plants. Other tested species showed no dependence on nitrification and temperature.

*Waste water treatment, *Activated sludge, *Treatment facilities, *Microscopy, *Protozoa, Temperature, Nitrification, Pilot plants

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D224

ELIMINATION OF TRACE-ELEMENTS BY SLOW-SAND-FILTRATION (ELIMINIERUNG VON SPURENMETALLEN DURCH LANGSAMSANDFILTER),

Schoettler, U.

Zeitschrift fuer Wasser- und Abwasserforschung, Vol. 9, No. 3, p 88-93, 1976.
17 fig, 1 tab.

The behavior and cleansing capacities of a biologically based filtration system for zinc, cadmium, copper, lead, arsenic, and chromium were estimated by long-term tests with simulated slow-sand-filtration. EDTA's remobilizing ability was subsequently tested, underscoring complexing agents which are important in water treatment. Algae and the sand used for filtration were analyzed to determine changes during testing. The filters sufficiently eliminated all trace-elements except cadmium and arsenic.

*Waste water treatment, *Biological treatment, *Treatment facilities, *Trace elements, *Filtration, Sands, Zinc, Cadmium, Copper, Lead, Chromium

Sand filters, Slow sand filtration, Arsenic

D225
COMBINED INCINERATION OF DOMESTIC WASTE AND SEWAGE SLUDGE
(L'INCENERIMENTO COMBINATO DEI RIFIUTI SOLIDI URBANI E DEI
FANGHI DI FOGNA),

Andrenucci, M., Lensi, R., and Moszi, G.

Facolta di Ingegneria dell'Universita di Pisa,
Pisa, Italy,
Istituto di Macchine.

La Termotecnica, Vol. 30, No. 4, 2 p, April, 1976.

The theoretical and practical possibilities of designing incinerators capable of burning sludges with high moisture content through the pre-heating of combustion air are examined. As a result of numeric calculations it has been shown that sludge can be burned at up to 85% moisture content. This fuel water content suggests a different solution from those previously chosen in designing conventional incineration furnaces.

*Incineration, *Domestic wastes, *Sewage sludge, *Moisture, *Heating, Air temperature, Design, Burning, Equipment, Facilities, Waste disposal, Sludge disposal

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D226
WASTE WATER TREATMENT — A NEW CONCEPT (EPURATION D'EAUX
RESIDUAIRES — NOUVELLE CONCEPTION),

Informations Chimie, No. 152, p 165-166, February, 1976. 1 tab.

When activated carbon is located downstream from a biological waste water treatment installation, adsorption is frequently blocked by bacteria colonies. By placing the activated carbon upstream, the water's pH is kept fairly low, thereby minimizing bacterial growth. To optimize these conditions, a material was developed, Tecflow, which, in a first zone, acts as a fluidized bed adsorbent, and, in a second zone, as a fixed bed adsorber floating on the fluidized bed. This system allows for the percolation of waters containing up to 100 mg of suspended matter, thereby avoiding primary decantation which generally produces diluted and hard to dispose of sludge. A blockage of about 20% COD will lower toxicity concentrations by 50-70% after passage on Tecflow. Trials in a waste water plant producing 1,000 cu m/d of various solvent and industrial wastes effected a 99% BOD and 98% COD decrease.

*Waste water treatment, *Biological treatment, *Adsorption, *Percolation, *Suspended solids, Chemical oxygen demand, Biochemical oxygen demand, Activated carbon

*Tecflow

D227
PERFORMANCE COMPARISON SURVEY OF THE PUBLIC SEWAGE-TREATMENT PLANTS IN BADEN-WUERTTEMBERG 1975 (LEISTUNGSVERGLEICH FUER KLAERANLAGEN 1975 IN BADEN-WUERTTEMBERG),

Burchard, C-H.

Forum Umwelt Hygiene, Vol. 27, No. 5, p 175-177, 1976. 3 tab, 3 ref.

Since 1972 Baden-Wurttemberg has had codes controlling public sewage treatment plants. Advanced training for operators of sewage works provides the necessary knowledge for bringing about this control. A "Performance Comparison Survey" of the public sewage treatment plants in Baden-Wurttemberg was conducted for the second consecutive year in 1975. The purification procedure requirements were satisfied by 52% of the public sewage treatment plants operating in Baden-Wurttemberg. Outstanding purification performances were demonstrated by one out of seven plants.

*Waste water treatment, *Sewage treatment, *Sewerage, *Treatment facilities, *Europe, Public utilities, Training, Water purification

Germany

D228
PHYSICOCHEMICAL WASTEWATER TREATMENT METHODS,

Delichatsios, M. A.

Texnika Xponika, Vol. 44, No. 5, p 227-230, 1975. 3 fig, 9 ref.

Physico-chemical methods of waste water treatment use coagulation and sedimentation to remove suspended solids, and carbon adsorption columns to remove organic matter. Compared with biological treatment methods, these methods operate reliably for varying qualities of waste water and have improved economy and efficiency. The basic laws in such a system with respect to the phenomena of coagulation, breakup and sedimentation of the suspended solids in turbulent flows have been developed. Knowledge of these laws leads to intelligent design of systems for waste water treatment. A new system using coagulation in turbulent pipe flows was proposed with the advantage of substantially reduced space requirements compared with traditional systems.

*Waste water treatment, *Biological treatment, *Treatment facilities, *Coagulation, *Adsorption, *Sedimentation, Suspended solids, Organic matter

*Physico-chemical treatment

D229

A CONTRIBUTION TO STABILIZATION PONDS DESIGN,

Kollias, P. S.

Texnika Xponika, Vol. 44, No. 5, p 219-225, 1975. 3 fig, 5 ref.

Stabilization ponds are shallow basins treating organic wastes, especially sewage, by storing it under conditions favoring natural biological treatment. Stabilization ponds may be used alone or following preliminary treatment. The processes occurring simultaneously include sedimentation and bioflocculation, aerobic bacterial oxidation, and photosynthesis. Applications of these ponds and their classification, performance, and design criteria are discussed. An empirical equation with a rational basis for the volume of stabilization is given. Experimental ponds and biochemical oxygen demand (BOD) efficiency are discussed and the method of design is described analytically. A sample system serving a population of 4500 inhabitants near Mer a Aude is described.

*Waste water treatment, *Sewage treatment, *Biological treatment, *Sewerage, *Oxidation lagoons, *Treatment facilities, Biochemical oxygen demand, Design criteria

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D230

MICROBIOLOGY OF WASTE TREATMENT,

Unz, R. F.

Journal Water Pollution Control Federation, Vol. 48, No. 6, p 1367-1378, June, 1976. 101 ref.

A literature review of papers dealing with the microbiology of waste water treatment is presented. General topics covered include: sanitary microbiology and disinfection, waste water microbial dynamics, the toxicity of metal ions, the behavior of biopolymers, the existence of nuisance microorganisms, the nutrient composition of waste waters, biodegradation, anaerobic microbiology, and the occurrence of microbial byproducts as a result of waste water treatment. Specific topics discussed under the above general headings include: the development of selective agars for the recovery of fecal streptococci from waste water, the adsorption of several types of viruses by suspended matter in waste water, changes in the composition and density of microbial populations in waste water transported through activated sludge treatment plants, methods for determining the biodegradable fraction of activated sludge, the degradation of metal chelated nitrilotriacetate complexes by Pseudomonas strains of bacteria, the failure of Leuconostoc mesenteroides to flocculate during the synthesis of an extracellular polymer, luxury phosphate uptake by activated sludge, the development of a shake flask procedure for the biodegradability screening of pollutants, and studies of single cell protein production in synthetic waste waters.

*Microbiology, *Waste water, *Waste water treatment, *Microorganisms, Nutrients, Bacteria, Viruses, Polymers, Metals, Ions, Toxicity, Activated sludge, Treatment facilities, Biodegradation, Byproducts, Suspended solids, Adsorption, Flocculation, Nitrilotriacetic acid, Phosphates, Analytical techniques

D231
WASTEWATER TREATMENT - PHYSICAL AND CHEMICAL METHODS,

Scaramelli, A. B., and DiGiano, F. A.

Massachusetts University,
Amherst,
Department of Civil Engineering.

Journal Water Pollution Control Federation, Vol. 48, No. 6, p 1086-1096, June, 1976.
112 ref.

A literature review of physical and chemical methods of waste water treatment is presented. General topics covered include: process applications, coagulation and solids separation, adsorption, ion exchange, membrane processes, and ozonation. Examples of specific topics discussed under the above general headings include: quantitative evaluations of the total environmental impact of advanced waste water treatment, studies of the precipitation of phosphorus with lime, a comparison of the adsorptivity of activated carbons produced from lignite and bituminous coal, the use of ion exchange resins for the removal of humic acids, the use of reverse osmosis coupled with conventional waste water treatment, and the use of ozone for the removal of ammonia from waste water.

*Waste water treatment, *Membrane processes, *Coagulation, *Separation techniques, *Ion exchange, *Reverse osmosis, *Adsorption, Ozone, Activated carbon, Chemical precipitation, Phosphorus, Lime, Organic acids, Ammonia, Environmental effects, Treatment facilities, Chemical properties, Physical properties

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D232
SLUDGE TREATMENT, UTILIZATION, AND DISPOSAL,

Dick, R. I.

Delaware University,
Newark,
Civil Engineering Department.

Journal Water Pollution Control Federation, Vol. 48, No. 6, p 1137-1166, June, 1976.
340 ref.

A literature review of papers dealing with the treatment, utilization, and disposal of sludge is presented. Topics covered include: problems encountered by the Environmental Protection Agency in securing public support for land-based alternatives to ocean disposal, regional industrial sludge reclamation and disposal facilities, the treatability of sludges removed from septic tanks, options for sludge treatment and disposal in the pulp and paper industry, the effects of various phosphorus removal techniques on the quantity and quality of sludge produced at waste water treatment plants, processes for improving the dewatering of activated sludges, the heavy metal contents of different sludges, an automated spectrophotometric technique for measuring the suspended solids concentration of activated sludge, the influence of sludge characteristics and polymer properties on the selection of polymers for chemical sludges, direct slurry freezing of activated sludge using butane, the application of dissolved air flotation thickening to mixed primary and secondary sludges, the pyrolysis and combustion of sludge, industrial uses for sludge, problems associated with the ocean disposal of sludge, and potential hazards associated with the application of sludge on agricultural land.

*Sludge treatment, *Sludge disposal, *Reclamation, Industrial wastes, Waste water treatment, Activated sludge, Spectrophotometry, Suspended solids, Analytical techniques, Byproducts, Oceans, Land use, Phosphorus, Heavy metals, Hazards, Polymers, Treatment facilities, Pulp and paper industry, Septic tanks

D233
WASTEWATER COLLECTION,

Singh, T., and Bhutani, J. S.

H. D. Nottingham and Associates, Incorporated,
McLean, Virginia.

Journal Water Pollution Control Federation, Vol. 48, No. 6, p. 1170-1174, June, 1976.
42 ref.

A literature review of papers dealing with waste water collection is presented. General topics covered include: planning, design, and construction considerations; inspection, monitoring, and maintenance activities; waste water pumping; and economic considerations. Specific subjects discussed under the above general headings include: the separation of combined collection systems into sanitary and storm sewers, the use of polyethylene pipe for collection systems, the advantages of pressure sewers over conventionally used gravity flow collection systems in areas with difficult terrain, a management program for the operation and maintenance of a waste water collection system, the restoration of deteriorated sewers, the limitations of current methods for identifying infiltration/inflow in sewer systems, improvements in the capability of existing lift stations, and the economic impact of infiltration and inflow problems associated with waste water collection systems.

*Sewers, *Conveyance structures, *Waste water treatment, Pipelines, Pumping plants, Infiltration, Inflow, Separated sewers, Materials, Monitoring, Inspection, Maintenance, Economics, Planning, Design criteria, Repairing

Collection systems

D234
LAGOONS AND OXIDATION PONDS,

O'Brien, W. J.

Black and Veatch Consulting Engineers,
Kansas City, Missouri.

Journal Water Pollution Control Federation, Vol. 48, No. 6, p 1107-1110, June, 1976.
38 ref.

A literature review of paper concerning lagoons and oxidation ponds is presented. Specific subjects covered include: mixing and heat exchange in aerated lagoons, the treatment of cheese processing wastes in a two-cell aerated lagoon, design procedures for ring-shaped ponds, mathematical equations for describing the operation of aerated and facultative lagoons connected in series, comparisons of the soluble organic carbon removal in conventional single-cell anaerobic ponds and in baffled ponds, a procedure for calculating the surface area of a facultative lagoon required to obtain a desired biochemical oxygen demand reduction, an analysis of the most cost effective treatment system for upgrading the effluent from oxidation ponds, the use of isolated periodic fill and draw final basins for upgrading the effluent from conventional facultative ponds, and structural configurations that facilitate zooplankton growth in oxidation ponds.

*Oxidation lagoons, *Lagoons, *Ponds, *Biological treatment, *Waste treatment, Aeration, Mixing, Industrial wastes, Design criteria, Mathematical models, Biochemical oxygen demand, Cost-benefit analysis, Heat transfer, Zooplankton

D235
MIXING AND TRANSPORT,

Ditmars, J. D.

Argonne National Laboratory,
Argonne, Illinois,
Energy and Environmental Systems Division.

Journal Water Pollution Control Federation, Vol. 48, No. 6, p 1620-1639, June, 1976.
199 ref.

A literature review of mixing and transport phenomena associated with surface waters and groundwater is presented. Specific topics discussed include: longitudinal dispersion processes in rivers; procedures for determining the assimilation capacity of streams; the hydrodynamics of large lakes; a model for the diurnal temperature distribution in a deep reservoir; a classification scheme for numerical models of water and waste movement in tidal bays and estuaries; measurements of a salt marsh drainage system; water quality forecasts for a number of small bays on the Florida coast; the development of finite-element models for one- and two-layer coastal circulation; the fluid mechanics of waste water disposal in the ocean; studies on the discharge of heated waters into rivers, lakes, estuaries, and oceans; the design and operation of a recirculating flume for the development of criteria for power plant intake screens; the effect of high initial dilution on the dispersion of fluid-solid mixtures dumped into the oceans; and studies on the spreading of oil on water surfaces under different conditions.

*Mixing, *Dispersion, *Hydrodynamics, *Groundwater, *Surface waters, Lakes, Oceans, Estuaries, Rivers, Reservoirs, Bays, Streams, Model studies, Industrial wastes, Waste water, Marshes, Drainage systems, Oil, Circulation

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D236
ANAEROBIC PROCESSES,

Ghosh, S., Conrad, J. R., Packer, M., and Van Ryzin, E.

Institute of Gas Technology,
Chicago, Illinois,
IIT Center.

Journal Water Pollution Control Federation, Vol. 48, No. 6, p 1115-1137, June, 1976.
120 ref.

A literature review of methods which utilize anaerobic processes is presented, with particular emphasis on waste water treatment. General topics covered include: microbiological and mechanistic studies, anaerobic denitrification studies, and process applications. Specific subjects discussed under the above general headings include: the isolation and identification of methanogenic bacteria, the use of labeled bicarbonate to determine the rate of bacterial methane formation, the efficiency of denitrification in Pseudomonas denitrificans grown in glutamate-limited batch and continuous cultures, the effect of cell residence time on the kinetics and stoichiometry of bacterial denitrification, methods for removing nitrogen from primary waste water in biological reactors without the use of supplemental organic carbon, the effect of toxic industrial wastes and retention times on loading and methane production in waste water digesters, the use of anaerobic acid-phase fermentation to precondition swine manure for subsequent aerobic stabilization, and the use of anaerobic processes for energy reclamation (methane production).

*Anaerobic conditions, *Biological treatment, *Anaerobic digestion, *Anaerobic bacteria, *Waste water treatment, Reclamation, Microbiology, Denitrification, Bicarbonates, Methane, Fermentation, Carbon, Toxicity, Industrial wastes, Kinetics, Bacteria, Pseudomonas

D237
SECOND ATTEMPT TO TREAT ANGLIA'S TOXIC WASTES,

Millbank, P.

Surveyor, Vol. 147, No. 4380, p 17, May 21, 1976. 1 tab.

Hales Industrial Services have re-applied to build an industrial liquid waste reclamation and treatment plant near Bury St. Edmunds, Suffolk. A previous application 3 yr ago provoked much local controversy, and the county planning committee finally rejected it. The new application omits incineration, which had attracted the most local criticism. The new plant is considered to be very much in the country's interests. It also has implications for surrounding counties. The plant will reduce the long distance haulage of waste material. The objectives of the plant are to recover scarce materials, render wastes harmless, and offer re-processing. Physical treatment will involve separation and filtration; chemical treatment will use reagents; and biological treatment will employ a high-rate filter. Up to 17,000 gallons of de-contaminated water and 30 tons of filter cake will be generated daily. The climate of informed opinion has shifted significantly in the direction of more regionalized treatment and disposal of notifiable wastes compared to when the original application was made.

*Waste water treatment, *Biological treatment, *Treatment facilities, *Industrial wastes, *Liquid wastes, Reclamation, Foreign countries, Attitudes

*Physical treatment, *Chemical treatment, *Toxic wastes

D238
SOD PRODUCTION: AN EXPERIMENT IN SLUDGE DISPOSAL,

White, W. T., Jr.

Public Works Administration,
St. Petersburg, Florida.

Public Works, Vol. 107, No. 6, p 104-106, June, 1976. 2 fig, 1 tab.

A project was begun in St. Petersburg, Florida, to use sludge from waste water treatment plants to develop topsoil and eventually grow sod for city parks and recreation areas. Sludge was distributed into furrows dug by a tractor and then blended with the soil using a tractor attachment. During the first yr, an 18 inch layer of topsoil was created, which produced superior grass growth when transferred to city parks and street parkways. A 23-acre area was used. The site was completely tile-drained at an average depth of 3.5 ft. The sandy soil had an interference of shell commencing at a depth of about 24 inches. The area was bordered by a 6 ft deep drainage ditch whose contents were pumped to a holding pond south of the site. Sludge solids were retained at the soil surface, part of the moisture evaporated, and any excess was collected by the drain tile and carried to the drainage ditch. Sludge spraying was discontinued for 3 days after a heavy rain, because an inch of rain contributed moisture equivalent to 3 days of operation.

*Turf, *Sludge disposal, *Sludge, *Topsoil, *Land use, Mixing, Grasses, Tile drainage, Soil types, Ditches, Solid wastes, Moisture

Sandy soils, Land application

D239

PERSISTENCE OF VIRUS ON SEWAGE-IRRIGATED VEGETABLES,

Larkin, E. P., Tierney, J. T., and Sullivan, R.

Bureau of Foods,
Cincinnati, Ohio,
Virology Branch.

Journal of the Environmental Engineering Division-ASCE, Vol. 102, No. EE1, p 29-35, February, 1976. 3 tab, 23 ref, 1 append.

The persistence of a human enterovirus, poliovirus 1, on lettuce and radishes fertilized with contaminated sewage wastes was studied. The contaminated wastes were obtained by mixing a suspension of poliovirus 1 with raw waste activated sludge or secondary sewage effluent which contained no naturally occurring viruses. They were applied with an apparatus simulating existing spray irrigation equipment. Filtrate from slurries of crushed lettuce, radish leaves, and radishes was assayed for virus using a plaque-forming method. Poliovirus 1 persisted on lettuce and radishes for up to 36 days. Since present treatment systems do not completely remove viruses from sewage sludge or effluent, municipalities contemplating sewage disposal on land should investigate the use of crops other than those in the food chain until treatment and monitoring methods are sufficiently improved to preclude the seeding of food crops with human pathogens.

*Waste water treatment, *Pollutant identification, *Viruses, *Persistence, *Irrigation effects, Sewage treatment, Activated sludge, Sewerage, Irrigation practices, Irrigation water, Sewage effluents

Spray Irrigation

D240

DESIGN OF INTEGRATED APPROACH TO NUTRIENT REMOVAL,

Eisenhauer, D. L., Sieger, R. B., and Parker, D. S.

Brown and Caldwell Consulting Engineers,
Walnut Creek, California.

Journal of the Environmental Engineering Division-ASCE, Vol. 102, No. EE1, p 37-54, February, 1976. 6 fig, 11 ref, 1 append.

The Central Contra Costa Sanitary District's Water Reclamation Plant currently being built near Concord, California, will produce water for industries located along the shores of Suisun Bay. Four miles of pressure pipeline will link the industries to the plant. Seventy-five percent of the reclamined water will be used for cooling and the remainder for process purposes. Reclaimed water in excess of industrial needs will be discharged to the bay. It will not harm the receiving waters because it will be virtually free of oxygen demanding materials, nutrients, and toxicants. The plant was designed following 2 yr of testing at the Advanced Treatment Test Facility (ATTF) at the site of the CCCSD's existing treatment plant. The new plant's treatment system combines lime clarification in the primary sedimentation tanks, biological nitrification-denitrification, a multimedia rapid sand filtration system for effluent polishing, a two-state sludge conditioning process, and a wet and dry lime classification process with recalcining and lime recovery. The plant is designed for expansion and will be constructed in increments as the need arises. Nitrogen will be removed to prevent algal growth in receiving waters and industrial water systems. Phosphorus will be removed to control calcium-phosphate scaling. A dual computer system will monitor and control the entire plant process.

*Waste water treatment, *Biological treatment, *Treatment facilities, *Water reuse, *Integrated control measures, Nutrients, Design, Reclamation, Reclaimed water, Industrial water

D241
INFLUENCE OF ACTIVATED SLUDGE CRT ON ADSORPTION,

Kim, B. R., Snoeyink, V. L., and Saunders, F. M.

Illinois University,
Urbana-Champaign,
Department of Civil Engineering.

Journal of the Environmental Engineering Division-ASCE, Vol. 102, No. EE1, p 55-70, February, 1976. 12 fig, 2 tab, 21 ref, 1 append.

The relationship between the operational characteristics of an activated sludge system and the concentration of nonadsorbable organic compounds present in the secondary effluent was studied. Activated sludge units were operated at cell residence times (CRT) of 0.8 days, 4.8 days, 12.3 days, and 19.4 days. Batch adsorption tests were conducted using secondary effluent from these systems. The equilibrium chemical oxygen demand (COD) for each was determined as a function of carbon dosage. Membrane separation techniques were used to fractionate the organic matter by size, in order to study the adsorption by activated carbon of the size fractions. Continuous flow column studies were also conducted. The CRT of an activated sludge system significantly affects the concentration of nonadsorbable organic matter in the effluent from the system. There was little change in the concentration of adsorbable material, however, particularly as the CRT was increased from 4.8 days to 19.3 days. The concentration of nonadsorbable material was not significantly affected by pH changes. Some nonadsorbable organic matter was present in each size fraction. Relatively simple laboratory batch tests can be used to determine the amount of nonadsorbable material in a waste water and thus to predict the best possible effluent achievable with a carbon column in the absence of biological activity. CRT should be considered as a new variable in addition to those currently used in designing treatment systems. The manner in which the secondary biological system is operated should be considered in any subsequent treatment of the effluent by activated carbon.

*Waste water treatment, *Activated sludge, *Chemical oxygen demand, *Treatment facilities, *Adsorption, Organic compounds, Effluents, Sewage treatment

*Cell residence time

D242
PHILADELPHIA SLUDGE: WHERE TO PUT IT?,

Civil Engineering-ASCE, Vol. 46, No. 6, p 60-62, June, 1976.

Philadelphia dumps at least part of its sewage sludge in the open ocean, but the Environmental Protection Agency (EPA) has ordered it to discontinue this practice by 1981. Increased mercury, nickel, lead, and nitrate concentrations have been detected at the dumpsites. There was no apparent evidence of accumulation of organics and nutrients or changes in phytoplankton populations. Philadelphia officials believe that the dumping should not be banned. They are, however, evaluating 10 treatment-disposal alternatives. These include giving away the dried sludge for use as a fertilizer. A Recycling Center may also be set up to handle sludge for shipment. Sludge will be applied on a trial basis to farmland south of the city. Use of sludge to reclaim strip-mined lands has also been considered. Because of expected objections, Philadelphia will cooperate with several universities in studying sludge application to strip-mined land. In similar tests using Scranton sludge, the alkaline sludge helped neutralize the acidic strip-mined land and added humus.

*Sewage treatment, *Sludge disposal, *Ultimate disposal, *Pennsylvania, *Sewage sludge, Atlantic ocean, Land use, Oceans

*Philadelphia (Pa)

D243

PERFORMANCE OF SINGLE HOUSEHOLD TREATMENT UNITS,

Otis, R. J., and Boyle, W. C.

Wisconsin University,
Madison,
Department of Civil and Environmental Engineering.

Journal of the Environmental Engineering Division-ASCE, Vol. 102, No. EE1, p 175-189, February, 1976. 6 fig, 5 tab, 8 ref, 1 append.

Eight installations at private homes in Wisconsin were used to test anaerobic and aerobic household waste treatment processes. These included six systems with single compartmented septic tanks, one with two septic tanks in series, two with continuous flow-through extended aeration units, and one with a batch aeration unit. Samples from each step in the treatment process were analyzed for biochemical oxygen demand (BOD), chemical oxygen demand (COD), solids, total nitrogen, phosphorus, total and fecal coliform, and fecal streptococcus. Effluents from aerobic units had mean concentrations of 47 mg/liter BOD and 53 mg/liter total suspended solids (TSS) as compared to 158 mg/liter BOD and 54 mg/liter TSS in septic tank effluent. Most of the aerobic processes, however, would not meet current national secondary effluent BOD and TSS criteria without modification or additional processing. Septic tanks were more stable in seven of the 11 parameters tested. Nearly complete nitrification and some denitrification occurred in the aerobic units; ammonia and organic nitrogen dominated in septic tank effluent. The following appear beneficial in maintaining high effluent quality from aerobic units: a septic tank or trash trap preceding the aeration chamber to remove grease, floating solids, and large debris; flow equalization; returning floating solids at least twice daily; maintaining mixed liquor temperatures above 15 C; effluent weirs at least 24 in. long with scum and deflection baffles; and regular maintenance with inspections at least every 2 mo.

*Waste water treatment, *Pollutant identification, *Biochemical oxygen demand, *Chemical oxygen demand, *Treatment facilities, *Domestic wastes, Performance, Anaerobic conditions, Aerobic treatment, On-site tests, Septic tanks

D244

ALBUQUERQUE PLANT DESIGNED WITH COMPUTER IN MIND,

Ricoy, J. L., and Matotan, W. I.

William Matotan and Associates,
Albuquerque, New Mexico.

Water and Wastes Engineering, Vol. 13, No. 1, p 32-35, 37, January, 1976.

A new secondary treatment plant in Albuquerque is described. The new activated sludge waste water treatment plant includes a process control computer system, new laboratory testing equipment, and monitor sensors. The two existing plants incorporates trickling filters. In the new scheme, effluents from the two old plants combine and pass through a series of screw pumps to the aeration tanks, the final settling tanks, and then to the Rio Grande river for ultimate disposal. Aeration facilities were designed so that the plant can operate as either conventional tapered aeration, step aeration, or contact stabilization. Diffused air is used for mixing and oxygen needs. Final settling tanks are of rapid sludge removal type. Anaerobic digestion handles sludge solids, and the resulting gas is used to generate electricity through the system. Pumps and blowers are controlled by the computer on the basis of a running time inventory. This is also used as an aid in determining maintenance and overhaul schedules. Dissolved oxygen levels in the aeration tanks are continuously monitored by the computer. Algorithms are provided in the system for a wide variety of controls and samplings. The computer has a fixed head mass memory of 246K and a core memory of 24K, both expandable.

*Treatment facilities, *Waste water treatment, New Mexico, Activated sludge, Trickling filters, Aeration, Computers, Equipment, Settlement basins, Anaerobic digestion

Process control, Albuquerque (NM)

D245

HATFIELD TOWNSHIP, PENNSYLVANIA, ADVANCED WASTE TREATMENT PLANT,

Greenlund, T. W., and Gaines, F. R.

Tracy Engineers, Incorporated,
Camp Hill, Pennsylvania.

September, 1975. 223 p, 40 fig, 46 tab, 14 ref, 6 append. Technical Report PB-245 622.

Hatfield (Pa.) Township's Water Pollution Control Plant includes primary chemical treatment, secondary combined activated sludge and nitrification facilities, tertiary chemical tube clarification, and mixed media filtration. Phosphorus is removed in a combined primary-tertiary phase; operations personnel can optimize each process. Lime feed control by pH is easy, although primary sludges need not always be recirculated. Tube clarifiers and mixed media filters produce highly polished effluent. Some nitrification occurred but was difficult to control. Screening and grit removal ahead of the raw sewage pump station considerably reduces operating problems due to significant grit accumulations and sludge recirculation pump clogging. Surge storage tanks improve plant operation by regulating hydraulic flow and making waste characteristics more constant. These tanks should have a more positive mixing device than mechanical mixers; aerators would promote more vigorous mixing and retard septicity during the summer. Adding lime to pH 9.5 in the primary flocculating clarifiers produced average phosphorus removals of 72.1% primary and 92.3% overall. New anti-fouling probes may eliminate frequent acid washing and recalibration of the submersible electrodes in the primary flocculation chamber. The mixed-media filters removed about 50% of all suspended solids fed to them, and the tertiary tube clarifiers removed most secondary solids. Tertiary filters can be used to polish suspended solids and some BOD.

*Waste water treatment, *Sewage treatment, *Activated sludge, *Sewerage, *Treatment facilities, Biochemical oxygen demand, Tertiary treatment, Nitrification, Tubes, Filtration

Tube clarifiers

D246

KINETICS AND PROCESS CONTROL OF NITRIFICATION IN COMPLETELY MIXED BIOLOGICAL WASTEWATER TREATMENT,

Petrasek, A. C., Jr.

Dissertation Abstracts International B, Vol. 36, No. 12, p 6339-6340, June, 1976.

A study was undertaken to determine the nitrification kinetics in completely mixed activated sludge processes and define the nitrification process control requirements for these systems. The kinetics of ammonia nitrogen oxidation and organic nitrogen hydrolysis were evaluated with 25 batch tests under varying conditions. Organic nitrogen hydrolysis to ammonia nitrogen follows first-order kinetics; ammonia nitrogen oxidation has zero-order kinetics. The reaction rate for organic nitrogen hydrolysis was significantly faster than that for ammonia nitrogen oxidation. More importantly, the rate depended on sludge age. To further determine the complex relationships existing in biological waste water treatment processes, five years of data from the Demonstration Plant of the Dallas Water Reclamation Research Center were evaluated. Sludge age was the best indicator for microorganism growth rate. Excellent correlations were developed between sludge and ratio of food to microbes, gross yield coefficient and sludge age, sludge age and dissolved oxygen uptake rate, and sludge age and Kjeldahl nitrogen removal. The significant improvement in chemical oxygen demand (COD) removal for activated sludge system operation in which nitrification takes place was also quantified. Alkalinity's importance was identified in process control for nitrifying activated sludge systems. A decrease in alkalinity of 6.0 mg/liter is indicated for each 1.0 mg/liter of total Kjeldahl nitrogen that is removed or oxidized. The data also indicate that sludge age should be increased by 0.56 days for every Fahrenheit degree decrease in the temperature of the aeration basin.

*Waste water treatment, *Activated sludge, *Chemical oxygen demand, *Biological treatment, *Control, Nitrification, Oxidation, Hydrolysis, Testing, Ammonia, Organic compounds

D247
WASTEWATER TREATMENT FACILITY PARIS UTILITY DISTRICT,

Consulting Engineer, Vol. 46, No. 6, p 67, June, 1976. 1 fig.

Two industries and a town worked together for over a decade developing a sophisticated waste water treatment facility. The industrial-municipal plant, designed for combined domestic, tannery, and food processing wastes, eliminated the necessity for separate facilities. The two industries which had previously discharged inadequately treated waste to the Little Androscoggin River, now satisfy state and Federal waste discharge requirements. The city now has the services necessary for future industrial and residential development without river pollution. The facility treats about 1.35 mgd combined industrial and domestic wastes. The process controls and blends the waste streams for optimal performance, and incorporates several unusual operations. Automatic pumping systems for pH control optimize clarification removal and prevent release of odorous gases by sulfides in the waste. Chromium is removed by chemical precipitation brought about by equalizing two waste streams with pH control without added chemicals. Tannery stack gas serves as a carbon dioxide source reacting with free lime in industrial waste, forming calcium carbonate. Refractory chemical removal is optimized by unconventional upflow clarifiers. Maintenance and operation costs are reduced by separate sludge centrifugation. Other features that reduce costs and improve efficiency include a multiuse pumping system, automatic recording process controls and alarm systems, and a space and cost saving 800-kw turbine engine.

*Waste water treatment, *Treatment facilities, *Utilities, *Food processing industry, *Cities, Domestic wastes, Tannery wastes, Industrial wastes

D248
SEPTIC TANK EFFICIENCY,

Viraraghavan, T.

ADI Limited,
Fredericton, Canada.

Journal of the Environmental Engineering Division-ASCE, Vol. 102, No. EE2, p 505-508, April, 1976. 3 tab, 2 ref, 1 append.

A study on the actual performance of a rural household septic tank was carried out for the year 1973. Samples of raw sewage and septic tank effluent were analyzed for pH, total suspended solids (TSS), biochemical oxygen demand (BOD), chemical oxygen demand (COD), soluble organic carbon (SOC), total phosphates (PO4-P), ammonia nitrogen, nitrate nitrogen, total soluble iron, chlorides, total coliforms, fecal coliforms, fecal streptococci, Standard Plate Count (SPC), and Pseudomonas aeruginosa. About 20% of the TSS and 50% of COD and BOD were removed by the septic tank. There was very little indicator organism removal. However, over 80% of Pseudomonas aeruginosa was removed by the septic tank. Lower removals of TSS and bacteria may result from reentrainment of sedimented material into the effluent stream.

*Waste water treatment, *Pollutant identification, *Sewage treatment, *Severage, *Treatment facilities, Biochemical oxygen demand, Chemical oxygen demand, Septic tanks, Efficiencies

D249

ALUM SLUDGE DRYING WITH BASIC EXTRACTIVE TREATMENT,

Olson, R. L.

Resources Conservation Company,
Renton, Washington.

American Water Works Association Journal, Vol. 68, No. 6, p 321-323, June, 1976.
1 fig, 2 tab.

A new system has been developed to reduce problem sludges, including alum, to a dry state suitable for recycling or landfilling. The method, called B.E.S.T. (basic extractive sludge treatment), utilizes a solvent with unique properties that conditions both organic and inorganic sludges while enhancing the solids' dewatering and separation properties. The overall relative economics of the process depend on the specific sludge to be processed, the nature of existing alternatives for sludge disposal, and the availability of existing component hardware that can be incorporated into it. The process can satisfy all applicable Environmental Protection Agency (EPA) guidelines. When a combination of the solvent and water is cooled below approximately 65 F, they become completely mixed, whereas suspended solids contained in a liquid mixture are easily separated mechanically. Raising the liquid temperature to approximately 140 F allows the water and solvent to be separated by decanting. A Mini-B.E.S.T. unit was tested with various sludges to test the validity of the system. All system design goals were met during this testing. When the system was tested with alum sludge, the 52% liquid remaining in the filter cake was all solvent. The solvent has an evaporative value of 135 Btu/lb as opposed to approximately 1000 Btu/lb for water, resulting in one of the major energy economies in the B.E.S.T. system. The Mini-B.E.S.T. system was able to remove over 99% of the suspended solids from an organic sludge slurry and deliver 95% or more dry, pathogen-free solids and a clear, sterile effluent. Energy requirements are relatively low and environmental impact is negligible.

*Sludge, *Drying, *Sludge treatment, *Solvents, *Organic matter, Inorganic compounds, Dewatering, Economics, Suspended solids

*Basic extractive sludge treatment

D250

A NEW APPROACH TO THE DESIGN OF FILTRATION SYSTEMS,

Freshwater, D. C.

University of Technology,
Loughborough, England,
Department of Chemical Engineering.

Filtration and Separation, Vol. 13, No. 3, p 244-248, May-June, 1976. 9 fig, 2 tab, 8 ref, 1 append.

It is important, in designing solid-liquid separation processes, to consider the system as a whole and not simply the individual design and specification of the separate plant items. First the problem must be defined, including the nature of the feed, the changes that may occur during filtration, and the desired product quality. Then several alternative processing systems are chosen for consideration in detail. The alternatives are then assessed, beginning with calculating the material balance over the system. After the most appropriate system is chosen, it is optimized to produce the given throughput at a minimum cost. Allowance must be made for uncertainty, including variations in feed, environmental conditions, and throughput. Reliability theory may be used to assess the success probability of a given design.

*Waste water treatment, *Analytical techniques, *Treatment facilities, *Design, *Filtration, Suspended solids, Liquids, Optimization

D251

A FRESH APPROACH TO MICROSTRAINING,

Arnold, D. L. B.

Filtration and Separation, Vol. 13, No. 3, p 272-278, May-June, 1976. 8 fig, 1 tab.

In microstraining, water is strained under a low differential head through a fine woven fabric in a rotating drum. The suspended matter retained by the mesh contributes to straining efficiency by effectively reducing the size of the pores in the fabric. Microstrainer design is discussed, including construction, fabric panels, backwashing, driving system, hydraulics, structure and housing. Filter fabrics are usually made of stainless steel or, where the possibility of corrosion exists, plastic. The aperture-size is usually between 20 and 40 microns. The removal efficiency is determined by the mechanics of mat formation. Microstraining is used for water supply after treatment as well as for tertiary treatment of biologically purified sewage, generally after sedimentation. The Filtester, a small, inexpensive device, can be used to determine the capacity of a microstrainer. It filters a sample of the water to be treated through a piece of clean microfabric, determining the volume of water filtered in a time interval corresponding to the submersion time of an element of microfabric in normal microstrainer operation.

*Waste water treatment, *Sewage treatment, *Sewerage, *Filters, *Filtration, Fabrics, Suspended solids, Efficiencies, Pores, Size

*Microstraining

D252

ANTHRACITE ACTIVATED CARBONS: MANUFACTURE AND APPLICATIONS,

Batchelor, J. S.

Filtration and Separation, Vol. 13, No. 3, p 316, May-June, 1976. 7 ref.

Anthrasorb activated carbons are manufactured from anthracite. The manufacturing process, characterization, quality control, and technical services are described. The largest markets in liquid phase adsorption are the sugar industry and water and effluent treatment. Activated carbons are important in treating both potable water and effluents. One grade of Anthrasorb is extensively used to dechlorinate water on ships and oil rigs. Granular Anthrasorb is widely used for effluent treatment applications as diverse as removal of detergents from vehicle washing plant waters and removal of biocides from effluents at a pesticide plant. Other liquid and vapor phase applications are also discussed.

*Waste water treatment, *Coals, *Activated carbon, *Industrial production, *Adsorption, Quality control, Potable water, Effluents, Detergents, Pesticide removal, Liquids, Gases

Dechlorination

D253

TURN SEWAGE INTO FUEL,

Canadian Chemical Processing, Vol. 60, No. 6, p 4, 6, June, 1976. 2 fig.

A sewage treatment process under development produces a combined coal and sludge by-product that could be used as fuel. A filter bed of finely crushed coal is used to give a final biological oxygen demand of under 2 ppm and a 90% reduction in heavy metal ions. Effluent is charged from the upper part of the settling tank; suspended solids and additional pollutants settle to the bottom where they combine with coal particles for removal from the system. The supernatant liquid flows into a sump tank surrounding the settling tank. The filter bed absorbs cadmium, iron, chromium, manganese, zinc, and copper ions, along with wastes that induce biochemical oxygen demand (BOD) at between 0.5 and 0.6 gm/gm of coal. The treated water flows from the outer edge of the filter bed into another cylindrical tank where it is charged onto a sprinkling filter bed of coal to be treated further. A rake arm on the inclined lower part of the structure rakes out loaded coal particles in small portions from the lowest part of the filter bed. This sludge is then raked to the tank's center-well, where a bucket conveyor raises it to the upper part of the structure for disposal along with suspended solids and other wastes from the settling tank. One kg of coal sludge is generated for each cu m of waste water treated. It contains up to 60% water and can provide a minimum of 2,000 cal/gm when burned. The sludge could supply up to 15% of the required fuel for a power plant. Its heavy metal content would present no problem; it would be collected in the ash residue.

*Waste water treatment, *Sewage treatment, *Sewerage, *Biochemical oxygen demand, *Treatment facilities, Fuels, Coals, Filters, Ions, Cadmium, Iron, Chromium, Manganese, Zinc, Copper

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D254

EFFLUENT IRRIGATION OF RYE AND RYEGRASS,

Overman, A. R., and Ku, H-C.

Florida University,
Gainesville,
Agricultural Engineering Department.

Journal of the Environmental Engineering Division-ASCE, Vol. 102, No. EE2, p 475-483, April, 1976. 4 fig, 6 tab, 12 ref, 2 append.

Rye and ryegrass grown on sandy soil in Florida were irrigated with secondary effluent. Forage was weighed after harvesting and samples were analyzed. Both responded well to irrigation with secondary municipal effluent. Dry matter yields showed a positive response to increased irrigation rates. Dry matter content decreased with irrigation, since soil moisture was more available to plants. Nutrient uptake generally increased and recovery efficiency declined with application rate. The effluent was deficient in potassium relative to other elements for production of rye or ryegrass. Potassium uptake exceeded applied potassium for most irrigation rates for both crops. Supplemental potassium might improve crop production with effluent irrigation.

*Effluents, *Irrigation, *Soil types, *Florida, *Forages, Weight, Harvesting, Rates of application, Soil moisture, Nutrients, Potassium, Absorption, Crop production

*Rye, *Ryegrass

D255
RECOVERY OF P205 FROM WASTE-WATERS BY ADDING LIME (SEKKAI SHORI NI YORU HAISUICHU NO P205 NO KAISHU),

Kekko to Sekkai, No. 142, p 111-113, May, 1976. 3 fig, 2 tab, 4 ref.

Adding lime to recover phosphorus pentoxide in waste water from wet process phosphoric acid plants was studied by means of laboratory tests. The products were also analyzed. Prior to phosphorus pentoxide precipitation, most of the fluorine was precipitated as calcium fluoride at pH 3 to pH 4; the remainder of the phosphoric acid was then precipitated as fine apatite crystals. The size of the apatite crystals varied with the amount of fluorine in the waste water. Although citrate solubility varied with the crystal size, all of the apatite was entirely soluble in a 2% solution of citric acid.

*Waste water treatment, *Phosphorus compounds, *Waste water (pollution), *Lime, *Chemical wastes, Laboratory tests, Chemical analysis, Chemical precipitation, Fluorine, Crystals, Solubility

*Phosphorus pentoxide

D256
WASTEWATER DISPOSAL BY SUBMERGED MANIFOLDS,

Liseth, P.

I. S. Miljoplan,
Hovik, Norway,
Water Pollution Section.

Journal of the Hydraulics Division-ASCE, Vol. 102, No. HY1, p 1-14, January, 1976. 8 fig, 13 ref, 1 append.

The mixing of buoyant jets from a long submerged manifold for waste water disposal discharging into stagnant receiving water of uniform density was studied by means of hydraulic model experiments. The manifold studied was a pipe with round ports along both sides, issuing jets horizontally from the ports. The dilution and flow pattern of the jets was altered when merging of the jets occurred. The ratio of the vertical distance above the manifold to the distance between the ports along the manifold determined the merging effects. When this ratio was between zero and five, there were no significant differences in the center dilution as compared to that of a single jet. For ratios greater than five, the jets gradually merged into a two-dimensional plume over the manifold, rapidly reducing the center dilution. For a given discharge load per length of manifold, ratios between five and 10 produce the highest center dilution of the jets.

*Hydraulics, *Laboratory tests, *Mixing, *Waste water (pollution), *Waste water disposal, Waste dilution, Orifices, Outlets

Manifolds, Submerged orifices

D257

THE USE OF FLUID CATALYTIC CRACKING CATALYST IN ACTIVATED SLUDGE WASTEWATER TREATMENT,

Schwartz, R. D., and McCoy, C. J.

Exxon Research and Engineering Company,
Linden, New Jersey,
Corporate Research Laboratories.

Journal Water Pollution Control Federation, Vol. 48, No. 2, p 274-280, February, 1976.
2 fig, 5 tab, 5 ref.

Regenerated spent fluid catalytic cracking catalyst was assessed as an enhancer of conventional activated sludge water treatment systems and compared with activated carbon. Activated sludge and waste water were obtained from a refinery and a municipal sewage treatment plant. The sludge was allowed to settle for one hour, after which the supernatant was removed and replaced with waste water. The sludge-waste water mixture and either cracking catalyst or activated carbon were incubated at 30 C and shaken, after which the sludge settling rate and percentage settling by volume, and the percentage transmittance at 660 nm and total organic carbon (TOC) of the supernatant were measured. The catalyst increased the sludge settling rate, decreased the settled sludge volume and supernatant TOC, and increased supernatant clarity of a refinery activated sludge system as compared with conventional activated sludge treatment alone. It markedly reduced phosphate levels in a municipal sewerage activated sludge system. The catalyst may be acting like other aluminas and alumina-silicates, which absorb microorganisms and organic compounds. Results with refinery activated sludge were more promising than those with municipal sewerage activated sludge. Because of a dilute sludge and low initial TOC levels in the waste water, however, the municipal sewerage activated sludge may not have been a suitable test system. The observed effects may result from the support adsorbing contaminants directly, providing a surface on which the microbial population can adsorb, and promoting sludge settling and compaction by acting as a nucleation center for the bio-floc, particularly for the finer particles.

*Waste water treatment, *Sewage treatment, *Activated sludge, *Sewerage, *Catalysts, Activated carbon, Waste water (pollution), Industrial wastes, Municipal wastes

Refinery wastes

D258

REMOVAL OF PHOSPHORUS AND NITROGEN FROM WASTEWATER BY SPRAY IRRIGATION OF LAND,

Shah, D. B.

Dissertation Abstracts International B, Vol. 36, No. 12, p 6249-6295, June, 1976.

Spray irrigation of land is being considered for the removal of phosphorus and nitrogen from waste water. Various reactions such as phosphorus adsorption, nitrification, and denitrification were studied, and mathematical models were developed to predict their movements in soil. The phosphorus model was derived using material balances on water and on phosphrous in the liquid and solid phase. It was assumed that non-equilibrium conditions prevail between phosphorus concentration in the liquid phase and on the soil. The water transport equation was dropped when it was determined that the water front moved much faster than the phosphorus front. Results of the simulation compared remarkably well with data from a spray irrigation site, and the soil system was efficient in phosphorus removal. Kinetic constants for the nitrification and denitrification reactions were evaluated. It was determined that nitrification can be considered a first order reaction in the range of nitrate concentrations encountered in waste water and that three times as much organic carbon is required as nitrate nitrogen for complete nitrogen removal. Material balance equations were written for ammonium nitrogen and nitrate nitrogen in the liquid phase and all the gas phase components. The simulation results compared very well with the experimental results; complete nitrogen removal was not accomplished even at very low flow rates. The nitrogen removal ability of the soil was found to be more important than its phosphorus removal capability in selecting a land disposal site.

*Waste water treatment, *Phosphorus, *Nitrogen, *Irrigation, *Waste water (pollution), Adsorption, Nitrification, Denitrification, Mathematical models, Soil water movement, Soils

D259

THE OPERATION OF A SIMPLEX ACTIVATED SLUDGE PILOT PLANT IN AN ATMOSPHERE OF PURE OXYGEN PART 2,

Wood, L. B., King, R. P., Durkin, M. K., Finch, H. J., and
Sheldon, D.

The Public Health Engineer, Vol. 4, No. 3, p 67-75, May, 1976. 13 fig, 3 tab, 20 ref.

Discussion is continued of a study of the use of oxygen to replace air in the activated sludge process, particularly with respect to more rapid oxidation of the carbonaceous substrate, more rapid oxidation of ammonia, and the production of smaller quantities of activated sludge with better settling characteristics and higher solids content. There was no evidence of a higher rate of carbonaceous substrate removal on a kinetic basis. Nevertheless, high dissolved oxygen concentrations are attainable, and higher mixed liquor solids can be maintained at higher plant loadings. The maximum growth rate of Nitrosomonas can be reduced in single-stage systems by low pH in mixed liquor where the latter is enclosed with oxygen, and carbon dioxide is allowed to build up in the gas space. No acclimatization to low pH is apparent. There is no reduction in the quantity of sludge produced. The growth rate associated with organisms oxidizing carbonaceous substrate is similar to that with air-based sludge yield. There was no evidence of increased sludge removal by endogenation and lysis. No special advantage was revealed by the settlement of the sludge as measured by the standard procedure and used for calculation of linear settlement rate. High sludge density indices apparently did not develop.

*Waste water treatment, *Activated sludge, *Pilot plants, *Oxygen, *Atmosphere, Air, Oxidation, Ammonia

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D260

WATER RECLAMATION AND REUSE,

English, J. N., and Mitchell, T. M.

Environmental Protection Agency,
Cincinnati, Ohio,
Wastewater Research Division.

Journal Water Pollution Control Federation, Vol. 48, No. 6, p 1174-1180, June, 1976. 57 ref.

A review of literature dealing with water reclamation and reuse is presented. Topics covered include: surveys of municipal waste water reuse, a simulation model for evaluating the economic efficiency of water reuse, the use of water recycle in poultry processing plants, automatic car wash water recycle systems, the use of ion exchange for the removal of color and minerals from kraft bleach plant waste, municipal irrigation systems, injection systems for using tertiary treated trickling filter effluent for groundwater recharge, a computerized model of a treatment system capable of producing potable water from secondary effluent, and modifications to existing waste water treatment systems to allow for future reuse of effluent.

*Water reuse, *Reclamation, *Reclaimed water, *Waste water treatment, *Recycling, Irrigation, Groundwater recharge, Model studies, Industrial wastes, Municipal wastes, Ion exchange, Treatment facilities, Potable water, Economics

D261
LAND APPLICATION OF WASTEWATER,

Tofflemire, T. J.

New York State Department of
Environmental Conservation,
Albany.

Journal Water Pollution Control Federation, Vol. 48, No. 6, p 1180-1191, June, 1976.
138 ref.

A literature review of papers dealing with the application of waste water to land via irrigation, overland flow, and infiltration is presented. Specific topics covered include: the loading constraints of land treatment systems, cost curves for general types of land application systems, research on the spray irrigation of lagoon effluent on mixed pine hardwood forests, systems involving spray irrigation and recycling to lakes, the advantages of drip or trickle irrigation over flood or ridge and furrow methods, shallow injection well recharge with tertiary effluent, techniques for conducting sanitary surveys, phosphate removals in duckweed irrigated with various amounts of secondary effluent, waste water nitrogen removal by crop irrigation systems, bacterial aerosols associated with spray irrigation of chlorinated secondary effluent, percolation tests for rapid infiltration system design, and disposal well operating problems and solutions.

*Water reuse, *Irrigation, *Overland flow, *Infiltration, Groundwater recharge, Economics, Injection wells, Bacteria, Percolation, Lakes, Surface waters, Groundwater, Land use, Symbiosis, Phosphates, Nitrogen

*Land application

D262
ACTIVATED SLUDGE,

Schroeder, E. D.

California University,
Davis,
Department of Civil Engineering.

Journal Water Pollution Control Federation, Vol. 48, No. 6, p 1098-1107, June, 1976.
110 ref.

A review of literature dealing with activated sludge processes is presented. Topics covered include: a two-state microbial growth model for explaining flocculation and deflocculation processes and varying cell yields, the modeling of contact stabilization processes, dynamic process control of activated sludge and nitrification processes using activated sludge, and the relationship of trace metal deficiencies to filamentous growths in activated sludge. Design criteria for activated sludge waste water treatment plants are presented, as well as an analysis of oxygen uptake rates in reacting and nonreacting systems, studies of deep tank aeration, processes available for nitrogen removal, the construction of a nominal plug flow nitrification process, pilot plant nitrification-denitrification studies in Sweden, the involvement of luxury uptake and cationic precipitation in phosphorus removal, phosphorus release during the anaerobic treatment of sludge, the application of a centrifugal screen for removing solids in activated sludge processes, and current trends and costs for package waste water treatment systems.

*Activated sludge, *Waste water treatment, *Sludge treatment, *Treatment facilities, Economics, Flocculation, Nitrification, Denitrification, Phosphorus, Chemical precipitation, Anaerobic conditions, Kinetics, Oxygen, Separation techniques, Design criteria, Model studies, Aeration, Nitrogen

D263

NITRIFYING ORGANISM CONCENTRATION AND ACTIVITY,

Srinath, E. G., Loehr, R. C., and Prakasam, T. B. S.

Union Carbide Corporation,
Tonawanda, New York.

Journal of the Environmental Engineering Division-ASCE, Vol. 102, No. EE2, p 449-463, April, 1976. 8 fig, 4 tab, 9 ref, 2 append.

A technique was developed to estimate the concentration of active nitrifying organisms in waste water mixed liquor. The oxidation rates for ammonium and nitrite in the mixed liquors were compared with those obtained with pure cultures of Nitrosomonas europaea and Nitrobacter agilis and N. winogradskyi suspended at known concentrations in a mineral salt medium containing their respective substrates. pH 7.4 to 7.9 was used as a reference to determine the rates, since this was the range where maximum rates occurred. The ratio of the specific oxidation rates of the nitrifying population of the mixed liquor and pure cultures under similar pH and temperature conditions represents the portion of the mixed liquor total Kjeldahl nitrogen (TKN) contributed by cellular TKN of autotrophic nitrifiers. This ratio yields the nitrifying organisms' TKN concentration when it is multiplied by the mixed liquor TKN concentration. The technique seems promising in aiding improved operation and design of nitrification processes and understanding the factors that affect these processes. The substrate concentrations did not affect the oxidation rates. The oxidation rates of nitrate and ammonium, at concentrations above 10 mg nitrogen/liter had zero-order kinetics. The pH influenced the oxidation rate. The pH optima were in the range of 7.4 to 7.9, and the concentration of nitrifying organisms in the system influenced the rate of oxidation.

*Waste water treatment, *Analytical techniques, *Microorganisms, *Nitrification, *Waste water (pollution), Oxidation, Rates, Nitrites, Cultures

*Mixed liquor

D264

BIOLOGICAL FILTERS,

Bunch, R. L.

Environmental Protection Agency,
Cincinnati, Ohio,
Treatment Process Development.

Journal Water Pollution Control Federation, Vol. 48, No. 6, p 1096-1098, June, 1976. 19 ref.

A review of literature dealing with biological filtration of waste water is presented, with particular emphasis on trickling filters and rotating biological contactors. Topics covered include: models for studying the performance of trickling filters, studies on the cost of trickling filter recirculation, the use of trickling filters containing a plastic medium for treating waste water from edible oil plants, studies of the growth kinetics of heterotrophic bacteria on plastic medium trickling filters, the ammonia nitrogen removal characteristics of rotating biological contactors, and patents for various waste water treatment systems employing rotating biological contactors.

*Biological treatment, *Waste water treatment, *Trickling filters, *Filtration, Model studies, Performance, Costs, Industrial wastes, Bacteria, Patents, Kinetics, Equipment, Ammonia, Nitrogen

D265

PRACTICAL ASPECTS OF ANAEROBIC DIGESTION,

Summers, R., and Bousfield, S.

Rowett Research Institute,
Aberdeen, Scotland.

Process Biochemistry, Vol. 11, No. 5, p 3-6, June, 1976. 1 fig, 2 tab, 18 ref.

The use of anaerobic digestion for waste disposal and energy production is discussed. Historically, the process has been used to reduce the pollutional load of strong, organic wastes of various kinds; recently the energy produced has become increasingly important. Anaerobic digesters are often used to treat domestic sewage. The gas produced may be used for heating needs at the digester site or for generating electricity. Some industrial wastes are suitable for anaerobic digestion, including sluaghterhouse, fruit and vegetable, alcohol fermentation, and pulp and paper wastes. Because of their strength, an aerobic digester is often used to treat such wastes on-site before discharging them into a public sewer. Farm wastes are very amenable to anaerobic digestion. Two types of anaerobic digesters are used for farm wastes: the small, warm-climate Gobar gas unit and larger, heated digesters used in temperate climates. Pilot plant tests for the larger systems showed that digestion must be built up gradually. Operational problems include greater scum formation than in domestic digesters and the need for more stirring. Even during cold weather, an aerobic digester using farm waste can produce more energy in the form of gas than is needed to run them.

*Waste water treatment, *Sewage treatment, *Sewerage, *Treatment facilities, *Anaerobic digestion, Waste disposal, Energy, Organic wastes

Energy production, Pollutional load

D266

FINAL REPORT REST AREA WASTEWATER TREATMENT AND DISPOSAL,

Pfeffer, J. T.

University of Illinois,
Urbana-Champaign,
Department of Civil Engineering.

November, 1974. 48 p, 4 fig, 12 tab, 15 ref. Technical Report PB-246 061.

Waste water treatment and disposal practices at interstate highway rest areas were studied. Rest area usage was analyzed to provide information regarding the quantity and quality of waste water as well as the variation in waste water flow. The information obtained has been used to evaluate potential waste water treatment systems for rest areas. The major criteria used to evaluate the systems were process stability under widely fluctuating loadings, simplicity of operation, and aesthetic qualities. A series lagoon system most nearly satisfies these criteria. An aerated lagoon can be used as the first cell of the lagoon system when land or excavation costs are high, greatly reducing land area requirements. For rest areas having inadequate water supplies, the waste water can be reused for nonpotable uses. A physical-chemical system will produce effluent that will satisfy the quality requirements for nonpotable reuse. This type of system was analyzed for this purpose. Previous phases of the project are summarized. They include an analysis of existing data on the quality and quantity of waste water from interstate highway rest areas and an analysis of potential treatment systems for these waste streams. Laboratory data were obtained for the chemical treatment of the waste water from a rest area and are presented.

*Waste water treatment, *Treatment facilities, *Water reuse, *Waste water disposal, *Aerated lagoons, Physical control, Highways, Water quality, Flow

Highway rest areas, Series lagoons, Physical-chemical treatment

D267
A TECHNICAL, ENVIRONMENTAL AND ECONOMIC EVALUATION OF THE "WET PROCESSING SYSTEM FOR THE RECOVERY AND DISPOSAL OF MUNICIPAL SOLID WASTE",

1975. 217 p, 34 fig, 20 tab, 9 append. Technical Report PB-245 674.

Results are presented of a technical, economic, and environmental evaluation of the wet processing concept for the disposal of solid waste. The facility studied was the Franklin Solid Waste and Fiber Recovery Plant, in Franklin, Ohio. The facility consists of three major systems; Hydrasposal (containing the pulping, separation, dewatering and incineration subsystems); fiber recovery; and glass recovery. When fiber recovery is not used, the facility requires additional water for pulping, but does not discharge water that would require treatment by a waste water treatment plant. With fiber recovery operational, the plant sends 2500 gallons of whitewater/ton of input refuse for treatment to the adjacent waste water treatment plant. Of the 3060 gallons of water/ton of input refuse required, 2300 gallons/ton comes from the final clarified water of the waste water treatment plant. Pulping and separation (P&S) involves dividing the solid waste into light and heavy streams. Waste water treatment sludge is introduced into the stream prior to the cone press dewatering step, the second of two steps in the dewatering process. The fiber recovery system receives the light fraction from the P&S subsystem and recovers a portion of the usable fiber contained in it. The impact on water quality as assessed by evaluating the influent and effluent flows. The output from the venturi scrubber does not require biological treatment, only solids removal. Eighty-one percent of the suspended solids loading and 73% of the biochemical oxygen demand (BOD) loading of the effluents leaving the plant are contributed by the effluent from fiber recovery. Economic data were developed for all major subsystems within the plant.

*Waste water treatment, *Biochemical oxygen demand, *Treatment facilities, *Recycling, *Solid wastes, Municipal wastes, Economics, Grants, Waste disposal, Evaluation

Municipal wolid waste, Demonstration grants, Wet processing

D268
AMMONIA REMOVAL FROM WASTEWATERS: A REVIEW OF THE STATE OF THE ART,

Whiting, J. H., and Adams, A. P.

United States Army Dugway Proving Ground,
Dugway, Utah.

January, 1976. 57 p, 9 fig, 2 tab, 15 ref, 2 append. Technical Report AD-A020 698.

Processes to remove ammonia from munitions plant waste streams were reviewed and evaluated. Various explosive wastes and high levels of ammonia and nitrates are present in these waste waters. Abatement regulations require removal of both the ammonia and nitrates. Several processes, such as air stripping, ion exchange, and breakpoint chlorination, are effective in the removal of ammonia from waste waters, but they do not reduce the nitrate concentration. Other processes must be used to remove the nitrates, imposing additional costs. Biological nitrification-denitrification effectively reduces both ammonia and nitrate concentrations in the waste water. Ammonia is biologically oxidized to nitrite, then to nitrate which, in turn, is reduced to nitrogen gas by the biological denitrification process. It is clean, efficient, and cost-effective. Reverse osmosis was also studied.

*Waste water treatment, *Ion exchange, *Reverse osmosis, *Ammonia, *Nitrification, Denitrification, Waste water (pollution), Industrial wastes, Evaluation, Nitrates

*Ammonia removal, *Nitrification-denitrification, *Air stripping, Breakpoint chlorination

D269

THE EVAPORATION AND DEGRADATION OF N-NITROSO DIMETHYL AMINE IN AQUEOUS SOLUTIONS,

MacNaughton, M. G., and Stauffer, T. B.

Air Force Civil Engineering Center,
Kirtland Air Force Base, New Mexico,
Environmental Chemistry Division.

March, 1975. 16 p, 6 fig, 8 ref. Technical Report AD-A020 922.

The fate of N-nitroso dimethyl amine (NDMA) in aqueous solutions and in a 25% caustic waste stream, which is produced in the manufacture of unsymmetrical dimethyl hydrazine (UDMH) was studied. The conditions were intended to approximate those which would effect evaporation, degradation, or both of NDMA in an open lagoon. NDMA in aqueous solutions is easily evaporated and photolyzed. Evaporation accounted for most of the removal in basic solutions, was low for acid solutions, and accounted for half the removal in neutral solutions. The rate of photolysis is higher in acid solutions. In acid and neutral pHs, nitrite severely inhibited the photolysis of NDMA. The evaporation rate was slightly increased by an increase in ionic strength. These results imply that the majority of the NDMA will volatilize from the solutions very rapidly unless the waste is neutralized. If the waste is neutralized and the heat of neutralization does not distill off the NDMA, photolysis will predominate unless nitrite is present. If nitrite were present in this situation, little of the NDMA would leave the lagoon either by volatilization or photolysis.

*Waste water treatment, *Geochemistry, *Environmental engineering, *Evaporation, *Degradation (decomposition), Aqueous solutions, Lagoons, Effluent streams, Public health, Environmental effects

N-nitroso dimethyl amine

D270

FUNDAMENTAL STUDY ON THE POST TREATMENT OF RO PERMEATES FROM ARMY WASTEWATERS,

Chian, E. S. K., and Kuo, P. P. K.

University of Illinois,
Urbana,
Environmental Engineering.

October, 1975. 131 p, 44 fig, 19 tab, 74 ref, 2 append. Technical Report ADA-021 476.

The removal of organic matter in MUST hospital waste water after the reverse osmosis (RO) process by treating with ozone, activated carbon, and ion-exchange resins was studied. Biological pretreatment of MUST waste water followed by ultrafiltration (UF), RO and ozone processes were also studied for the removal of gross organic matter. Pretreatment of RO permeates by activated carbon enhanced organic removal by ozonation while ion-exchange pre-treatment hindered its removal. Organic removal by both activated carbon and ion-exchange pre-treatment was enhanced when the RO permeates were pre-treated with ozone. The advantage of biological pre-treatment for reducing the power requirement for the later ozonation step was not obvious. The mechanism of organic removal by ozonation followed pseudo first order reaction kinetics during the early stage. Pseudo first order kinetics were also found in the second stage of ozonation, but at a greatly reduced rate. Stripping and distillation techniques and direct GC analysis were developed to analyze volatile organic compounds present in RO permeates. Solvent extraction coupled with high pressure liquid chromatography (HPLC) technique was developed to analyze nonvolatiles. Methanol and acetone were present in most of the RO permeates of MUST hospital wastes and o-toluidine and NN-diethyl-m-toluamide were present in the RO permeate of composite waste.

*Waste water treatment, *Pollutant identification, *Biological treatment, *Analytical techniques, *Tertiary treatment, Organic matter, Waste water (pollution), Ozone

D271

APOLLO COUNTY PARK WASTEWATER RECLAMATION PROJECT. ANTELOPE VALLEY, CALIFORNIA,

Brandt, H. T., and Kuhns, R. E.

County of Los Angeles,
Los Angeles, California,
Department of County Engineer.

March, 1976. 341 p, 78 fig, 37 tab, 33 ref, 1 append. Technical Report EPA-600/2-76-022.

Results of a full scale demonstration project to confirm previous pilot studies and research on the economics and feasibility of reclaiming waste water for use at an aquatic park in a semi-arid area are reported. An oxidation pond tertiary waste water treatment facility involving flocculation with alum, sedimentation, filtration, and disinfection was constructed. The treatment system performance and the characteristics of the lake waters were evaluated as they relate to chemical, physical, and biological quality, algal growth, plant growth, fish pathology, soil reclamation, and irrigation. An effluent was produced that meets all water quality requirements. Alum sludge recycled through the primary treatment plant and sludge digesters had no adverse effect on the treatment processes. The water quality in the lakes has a sufficiently low nutrient level to avoid eutrophication. The water is also usable for irrigation, but because of the high sodium percentage and the increases in the boron and dissolved salts due to evaporation, precautions will be necessary to maintain soil quality. The completed recreational park attests to the economic benefits and social acceptability of waste water renovation. The tertiary treated water is pathogenically safe, esthetically pleasing, suitable for fish life and aquatic sports, and acceptable for irrigational use.

*Waste water treatment, *Treatment facilities, *Waste treatment, *Nutrients, *Algae, Aquatic plants, Recreation facilities, Fish, Water reuse

Water reclamation

D272

TERTIARY TREATMENT FOR PHOSPHORUS REMOVAL AT ELY, MINNESOTA AWT PLANT, APRIL, 1973 THRU MARCH, 1974.

Sheehy, J. W., and Evans, III, F. L.

United States Environmental Protection Agency,
Cincinnati, Ohio,
Municipal Environmental Research Laboratory.

March, 1976. 133 p, 16 fig, 12 tab, 3 ref, 6 append. Technical Report EPA-600/2-76-082.

The design, the construction and the first year's operation of the 1.5 mgd tertiary treatment plant located in Ely, Minnesota are discussed. The tertiary treatment plant was constructed to reduce the amount of phosphorus in the effluent from the existing filter plant, a point source that produces 80% of the phosphorus and about 1% of the surface flow entering culturally eutrophic Shagawa Lake. The tertiary plant was designed and constructed to reduce the total phosphorus concentration in the trickling filter plant effluent to 0.05 mg/liter, and consists of flow equalization, two-stage lime clarification followed by dual-media filtration and chlorination. The cost of treatment averaged $0.24/cu m. Effluent total phosphorus concentration averaged 0.045 mg/liter. Performance data for the facility are included. The tertiary influent tank and the manually operated pump controller served to dampen hydraulic variations. The first-stage lime clarifier removed an average of 93.5% of the total influent phosphorus, while removal from two-stage clarification averaged 98%. The removal of soluble phosphorus, particulate phosphorus, and total phosphorus averaged 3%, 84% and 49%, respectively. Sludge handling problems encountered were high solids in the thickener overflow due to poor settling characteristics of the combined sludges and odors caused by processing undigested sludge. Conditioning sludge with lime increased the filter yield by 81%. Pertinent information on suspended solids, turbidity, TOC, calcium and iron removal is included. Waste water flow, chemical dose, pH, clarifier solids volume and gravity filter head loss are described.

D273

ULTRAVIOLET DISINFECTION OF ACTIVATED SLUDGE EFFLUENT DISCHARGING TO SHELLFISH WATERS,

Roeber, J. A., and Hoot, F. M.

Clow Corporation,
Florence, Kentucky.

December, 1975. 93 p, 12 fig, 13 tab, 7 ref, 6 append. Technical Report EPA-600/2-75-060.

A tertiary treatment plant and an ultraviolet disinfection chamber were installed following an activated sludge plant at a municipal sewage treatment plant. The effluent flows under ultraviolet lights through troughs. The amount of UV reaching the bottom of the trough is measured. If the UV is below a preset point known to give satisfactory disinfection, the effluent is automatically discharged to a holding lagoon instead of the receiving water. After the malfunction is corrected, the lagoon-stored effluent is pumped back through the plant for treatment. The determination of the coliform most probable number (MPN) was the primary evaluation test. MPN was not to be more than 70 per 100 ml. In static tests, an average ultraviolet dose of 25,000 microwatt sec per sq cm with an exposure time of 120 sec was required to produce an effluent with a coliform MPN Index less than 70. In flow-through tests, the coliform MPN was usually below 70 when the turbidity was below 11 JTU. The absorption of ultraviolet radiation was much more dependent on chemical oxygen demand (COD) than on turbidity. Exposure of samples to visible light after a sublethal dose of ultraviolet exposure favors the continued multiplication of bacteria. Bacteriophage inactivation followed first order kinetics. Coliform inactivation followed first order kinetics until 99.99% inactivation; followed by a tailing-off curve. Ultraviolet disinfection of effluents containing high solids and high organics was not possible.

*Waste water treatment, *Sewage treatment, *Activated sludge, *Severage, *Analytical techniques, Chemical oxygen demand, Treatment facilities, Disinfection, Ultraviolet radiation, Shellfish, Turbidity

Static tests

D274

ECONOMICAL RESIDENTIAL PRESSURE SEWER SYSTEM WITH NO EFFLUENT,

Hendricks, G. F., and Rees, S. M.

SIECO, Incorporated,
Columbus, Indiana.

December, 1975. 73 p, 18 fig, 10 tab, 4 ref. Technical Report EPA-600/2-75-072.

As the water level in Grandview Lake, Indiana, rose, it became polluted with effluent from septic tanks in the area. A conventional gravity sewer system and treatment plant would have been prohibitively expensive. A pressure sewer system with no polluting effluent was designed, constructed, and monitored for effectiveness. The elimination of groundwater infiltration and restrictive elevation tolerances associated with a conventional gravity sewer system enabled it to be installed and to function economically. Aerobic and anaerobic lagoon storage with subsequent irrigation of the effluent were used for treatment and yielded no more than normal volume of runoff. Inefficient home grinder-pump units resulted in operational problems with the pressure system. Commercially manufactured home units greatly reduced these problems and increases in home construction resulted, then, the initial irrigation area proved inadequate and additional irrigation areas were made available. Domestic sewage nitrogen and phosphate were largely converted to vegetation at a reasonable cost. The treatment method produced no objectionable odors. Some additional operation and maintenance problems were caused by ground raw sewage due to the nature of the solids. Homeowners should be educated in the proper operation and maintenance of their home units. Any check valves in the home units should have a gate that, when closed, is at an oblique angle from the perpendicular alignment of the centerline of the flow in the pipe in order to use the gravitational advantage. Mechanical seals should be used when possible in infield fabrication operations to prevent leakage due to high groundwater conditions.

*Waste water treatment, *Sewage treatment, *Severage, *Treatment facilities, *Sewers, Sewage, Sewage disposal, Lagoons

D275
STATE OF THE TECHNOLOGY SEMI-AUTOMATIC CONTROL OF
ACTIVATED SLUDGE TREATMENT PLANTS,

Nagel, C. A.

County Sanitation Districts of Los Angeles County,
Whittier, California.

December, 1975. 212 p, 59 fig, 14 tab, 1 append. Technical Report
EPA-600/2-75-058.

Devices that allow waste water treatment plant operators to monitor variable constituents, calculate important operating parameters, set and maintain proper process controls, and activate alarms are desirable, but present certain problems. The theory, design and operation of continuous on-line instrumentation currently in use by the County Sanitation Districts of Los Angeles County, California are documented, and computer applications which provide daily operational calculations are described. Aspects of instrumentation discussed include water level control of influent pumping, density control of primary sludge pumping, and process air, return sludge and waste sludge control in activated sludge plants. Theory, design, operation characteristics, and maintenance requirements are presented for each system. A computer application system provides daily operational parameters to the operators and prepares a monthly summary of operations reports. Other computer applications are reviewed, and a subroutine to compare effluent characteristics with discharge limits is included. These systems have proven to be reliable and practical.

*Waste water treatment, *Analytical techniques, *Treatment facilities, *Automatic control, *Data processing, Waste treatment, Waste water (pollution), Data storage and retrieval

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D276
RAW SEWAGE COAGULATION AND AEROBIC SLUDGE DIGESTION,

Jones, R. H., Burnszytnsky, T. A., and Crane, J. D.

Environmental Science and Engineering, Incorporated,
Gainesville, Florida.

November, 1975. 126 p, 31 fig, 16 tab, 20 ref, 4 append. Technical Report
EPA-600/2-75-049.

Chemical coagulation of raw sewage was studied with laboratory tests and at a sewage treatment plant. A clarifier was converted to a chemical coagulation reactor and clarifier, and polyelectrolyte addition evaluated at various dosages and mixing speeds. Although various polyelectrolytes were efficient in the laboratory, they were less so in full-scale tests due to inadequate mixing. Significant biochemical oxygen demand (BOD) and suspended solids reductions occurred over a range of electrophoretic mobility values. Aerobic digestion of primary sewage sludge was also studied at varying detention times, loading rates, temperature, sludge qualities, seasonal flow, evaporation, and precipitation. Aerobic digester waste sludge may contain 40% less chemical oxygen demand (COD), 80% less BOD, 11% less total solids, and 26% less volatile solids than undigested primary sludge. Operating conditions were optimized based on behavior of digested sludge on sand beds. Properly digested sludge dries in 4 weeks with no objectionable odor. Phosphorus was under 0.4% by dry weight, Kjeldahl nitrogen under 3.7%, and nitrate plus nitrite nitrogen under 0.8 mg/gm of dry sludge. COD, BOD, total and volatile solids were reduced 30 to 50% during 70 days lagooning. Aerobically digested sludge seem amenable to mechanical dewatering. Further gravity thickening was unsuccessful for digested primary sludge. Aerobic digestion stabilizes primary sewage sludge very well. Oxygen uptake rates up to 1.8 mg oxygen/(gm TS)(hr) occurred for digestion tests with sludge ages over 20 days.

*Waste water treatment, *Sewage treatment, *Sewerage, *Biochemical oxygen demand, *Chemical oxygen demand, Treatment facilities, Sludge digestion, Waste treatment

D277

IMPROVED LIQUID-SOLIDS SEPARATION BY AN ALUMINUM COMPOUND IN ACTIVATED SLUDGE TREATMENT,

Lenhart, C. F., and Cagle, J. W.

Board of Greene County Commissioners,
Greene County, Ohio.

September, 1975. 68 p, 34 fig, 3 tab, 9 ref. Technical Report EPA-600/2-75-039.

The effects of sodium aluminate additions on activated sludge waste treatment were studied. Periods with and without chemical dosing were compared. Feeding sodium aluminate to a small to medium activated sludge waste water treatment plant is practical for gaining several operational benefits, including improved solids handling, easier sludge volume index control, and improved concentration of aerobically digested solids, particularly in cold weather. Sodium aluminate reduced suspended solids carryout of secondary clarifiers, reducing the loading to the microstrainers used for tertiary treatment, and increased sludge density, permitting protection against solids washout during spot flows greater than 164% of designed plant capacity. Phosphorus removal approached 80%; alkaline alumina feed cost $.026 per 1000 gallons of waste water. Flow rates averaging 1.715 to 4.098 million gal per day, from 69 to 164% of design, were treated. Residual benefits accrued for 10 days after aluminate feed stopped; secondary clarifier conditions were not optimum until 3 days to a week after starting the aluminate. Solids settling in aeration basins and secondary clarifiers improved within 24 hr of startup. Thicker return sludge permitted a substantial reduction in waste activated sludge volumes. The secondary clarifier could retain higher MLSS. Return sludge volume rate was lower; less flow volume could deliver the same microorganism quantity. Chlorine demand was reduced; less solids and biochemical oxygen demand (BOD) entered the chlorine tank. BOD and SS loadings to the aeration tanks were reduced and increased concentrations of primary tank solids resulted when alumina was recycled.

*Waste water treatment, *Activated sludge, *Biochemical oxygen demand, *Treatment facilities, *Phosphorus, Sludge digestion, Sewage treatment, Suspended solids

Settling

D278

A VIRUS-IN-WATER STUDY OF FINISHED WATER FROM SIX COMMUNITIES,

Akin, E. W., Brashear, D. A., and Clarke, N. A.

United States Environmental Protection Agency,
Cincinnati, Ohio,
Water Quality Division.

September, 1975. 18 p, 9 tab, 4 ref. Technical Report EPA-600/1-75-003.

Six sites were chosen for a study of virus in water. They were Columbus, Ohio; Sidney, Ohio; Muncie, Indiana; Seymour, Indiana; Kansas City, Missouri, and St. Joseph, Missouri. Sites were selected on the basis of a treatment plant's use of surface source water with domestic contamination as indicated by high fecal coliform counts. An effort was also made to select sites using conventional procedures for flocculation or softening. Plants of various sizes, as indicated by output volumes, were chosen. The study was carried out to determine if the procedures and equipment presently available could detect human enteric viruses, and to test virus-sampling procedures and equipment in the field. A flow-through virus-adsorbent system was used. If viruses were present in these waters, the numbers were below the detectable level of a sensitive virus recovery procedure.

*Pollutant identification, *Treatment facilities, *Analytical techniques, *Viruses, *Municipal water, Cities, Ohio, Indiana, Missouri

D279

CURRENT CHLORINATION AND DECHLORINATION PRACTICES IN THE TREATMENT OF POTABLE WATER, WASTEWATER, AND COOLING WATER,

White, G. C.

In: Proceedings of the Conference on the Environmental Impact of Water Chlorination, October 22-24, 1975, Oak Ridge, Tennessee, Oak Ridge National Laboratory, p 7-24. 11 ref.

In sewage treatment, chlorine is used primarily for disinfection, but it is also effective for the prevention of septicity and the control of hydrogen sulfide generation. It is also used in limited applications such as control of activated sludge, bulking, sludge thickening, the destruction of cyanides, and foul air scrubbing. Chlorine is used in manufacturing ferric chloride, which is an effective coagulant for both potable water and waste water treatment. The amount of chlorine applied varies greatly, 50 to 400 lb per million gallon for waste water as compared to 5 to 100 lb per million gallon for potable water and 20 to 200 lb per million gallon for cooling water. In the final analysis the required use of chlorine in potable water and waste water depends on local and Environmental Protection Agency regulatory requirements. It was stated that there is no alternative to chlorine as a disinfectant and chemical tool in the treatment of potable water, waste water, and cooling water. While there appear to be some disadvantages such as the formation of some undesirable chloro-organics, no other oxidant can combine all chlorine's positive attributes, such as its potency and wide range of effectiveness as a germicide, and its ease of handling, application, measurement, and control.

*Waste water treatment, *Sewage treatment, *Treatment facilities, *Chlorination, *Water treatment, *Activated sludge, Disinfection, Hydrogen sulfide

Dechlorination

D280

CHLORINATION OF ORGANICS IN COOLING WATERS AND PROCESS EFFLUENTS,

Jolley, R. L., Jones, G., Pitt, W. W., and Thompson, J. E.

Oak Ridge National Laboratory,
Oak Ridge, Tennessee,
Chemical Technology Division.

In: Proceedings of the Conference on the Environmental Impact of Water Chlorination, October 22-24, 1975, Oak Ridge, Tennessee, Oak Ridge National Laboratory, p 115-152. 9 fig, 6 tab, 69 ref.

Available information concerning organic constituents in natural waters, including effluents from sewage treatment plants, is reviewed. Selected aspects of aqueous chlorination are discussed. Previous chlorination studies with sewage effluents and cooling water are summarized, and results from a recent study with a sample of cooling water are presented. Many water-soluble chlorine-containing organic compounds of low volatility were found in samples of chlorinated cooling waters from electric power-generating plants and chlorinated effluents from domestic sanitary sewage treatment plants. Both types of samples were chlorinated to milligram-per-liter chlorine concentrations in the laboratory under conditions similar to those used for treating cooling waters and disinfecting sewage effluents. High-pressure liquid chromatography was used to separate the chlorinated constituents from concentrates of the water samples. Chlorination yields (as Cl) of the chloro-organic compounds ranged from 0.5 to 3.1% of the chlorine dosage. The formation of chloro-organics and the reaction yields correlated with the chemical compositions of the samples. Several chloro-organics were quantified at the microgram-per-liter level in the domestic sewage effluents. A high degree of correspondence with respect to the elution positions of the separated constituents was revealed by comparison of the chromatograms of the chlorinated constituents in the cooling water samples with those of the sewage process effluent samples.

D281
FLOTATION: TWO FRESH WAYS TO TREAT EFFLUENTS,

Chambers, D. B., and Cottrell, W. R. T.

Chemical Engineering, Vol. 83, No. 16, p 95-98, August 2, 1976. 2 fig, 5 tab.

The treatment of waste water with electroflotation and microflotation techniques is discussed. Electroflotation, which involves the generation of bubbles by electrolysis, is especially recommended for low flow rates (less than 25 cu m/hr). Data compiled from 20 electroflotation units that treat industrial effluents in the United Kingdom indicate that electroflotation is a practical, first-stage treatment for reducing suspended solids, fats, and biochemical oxygen demand as well as for sludge thickening. Microflotation, which is a dissolved-air flotation technique, combines the benefits of advanced chemical flocculation with a novel and simple method for generating air bubbles which leads to the removal of solids, fats, and oils by flotation. In addition to its simplicity and ease of operation, microflotation requires little space. Large interfering air bubbles are absent, and solids removal is usually in excess of 99%. About 19 full-scale plants are operating in Sweden, and others are under construction in Finland, Norway, the United Kingdom, and Japan.

*Waste water treatment, *Flotation, *Bubbles, *Electrolysis, Industrial wastes, Suspended solids, Lipids, Biochemical oxygen demand, Oil wastes, Efficiencies, Sludge treatment, Flocculation

Microflotation, Electroflotation

D282
THE ROLE OF SOLAR ULTRAVIOLET RADIATION IN 'NATURAL' WATER PURIFICATION,

Calkins, J., Buckles, J. D., and Moeller, J. R.

Kentucky University,
Lexington,
Department of Radiation Medicine.

Photochemistry and Photobiology, Vol. 24, No. 1, p 49-57, July, 1976. 7 fig, 2 tab, 24 ref.

The effect of solar ultraviolet radiation on natural water purification was investigated by monitoring the concentration of Escherichia coli in the input and output of a tertiary waste water system (four lagoons) over an 11-month period and by measuring the integrated flux of biologically active solar ultraviolet radiation. A comparison of the die-off expected from solar ultraviolet exposure to the actual die-off observed for different batches of water was obtained by also determining the effective temperature of the system, the growth rate of Escherichia coli at the effective temperature, the penetration of solar ultraviolet radiation into the lagoons, the dose-response relation for the killing of Escherichia coli by ultraviolet radiation, and the retention time of water in the system. The observed killing of Escherichia coli was quite close to the values calculated, and solar ultraviolet radiation appears to be a very important factor in the natural purification of water.

*Water purification, *Coliforms, *Solar radiation, *Waste water treatment, *Tertiary treatment, Lagoons, Bacteria, Bactericides, Microorganisms, Mortality, Monitoring, E. coli

D283

A SURVEY OF PHOSPHORUS REMOVAL IN WISCONSIN,

Braasch, D. A., and Joeres, E. F.

Howard Needles Tammen and Bergendoff,
Milwaukee, Wisconsin.

Water Sewage and Works, Vol. 123, No. 7, p 70-73, July, 1976. 8 tab, 15 ref.

Phosphorus removal data are presented for 50 plants in the state of Wisconsin affected by the state's phosphorus removal policy. As of August 1974, 17 plants were achieving phosphorus removals from the influent exceeding 85%. Out of 50 plants providing treatment for phosphorus removal, less than half of the plants were attaining the required phosphorus reductions. Data are also presented on the types of phosphorus removal treatment being used by each plant; however the relative merits of alternative chemicals or treatment methods are impossible to evaluate because of local treatment problems and conditions. The major cost associated with phosphorus removal methods used in Wisconsin is the chemical cost. Treatment problems resulting in high chemical doses and the temporary nature of some chemical storage and feed facilities make the treatment costs difficult to interpret and evaluate.

*Waste water treatment, *Phosphorus, *Surveys, *Wisconsin, *Regulation, Costs, Evaluation, Performance, Treatment, Legal aspects, Chemical wastes

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D284

ESTIMATING THE RELIABILITY OF ADVANCED WASTE TREATMENT - PART 2,

Dean, R. B., and Forsythe, S. L.

Water Sewage and Works, Vol. 123, No. 7, p 57-60, July, 1976. 7 fig, 2 tab, 18 ref.

Statistical estimates of the long-term reliability of advanced waste treatment plants are discussed based on daily operating data covering six years of continuous operation at a waste treatment plant plus shorter records from other plants. Topics discussed include: artifacts produced by the logarithmic conversion of data, errors resulting from confusing the median with the mean when reporting data, and the probability of exceeding any finite upper limit when the performance of a plant obeys normal or lognormal statistics. The decision as to how specifications should be set is seen as being based on the effects of violations and, ultimately, on the internal cost of compliance in comparison with the external cost of violation. Examples of logarithmic plots of data are illustrated for biochemical oxygen demand, chemical oxygen demand, turbidity, coliform count, and residual chlorine.

*Tertiary treatment, *Statistical methods, *Reliability, *Treatment facilities, *Estimating, Biochemical oxygen demand, Chemical oxygen, Turbidity, Coliforms, Chlorine, Data collection

D285

WASTE-TREATMENT SYSTEM CUTS ENERGY REQUIREMENTS,

Chemical Engineering, Vol. 83, No. 16, p 57-58, August 2, 1976.

GaryGlas, a highly porous and rigid silica biological oxidation medium, is described as an economical alternative to more complex and more energy intensive aerated sludge treatment processes. Field tests on GaryGlas treatment systems varying in size from 40,000 to 2,100,000 gallons/day indicate that the medium does not require backwashing or forced aeration for the sustenance of the biological oxidation process. The material's intended use is as a secondary filter medium, although GaryGlas can also be used in tertiary polishing filters. Though priced about three times higher than competitive secondary treatment media, GaryGlas displays removal efficiencies that are 33-80% higher for both biochemical oxygen demand and total suspended solids. GaryGlas can be contained in vessels of concrete, fiberglass, or corrosion-proofed steel; the receptacle need offer only side support and wind resistance.

*Biological treatment, *Oxidation, *Energy, *Biological membranes, *Waste water treatment, Suspended solids, Biochemical oxygen demand, Materials, Efficiencies, Costs, Filtration

Secondary treatment, GaryGlas

D286

DIGESTION OF AQUEOUS WASTES WITH OXYGEN PRESSURE-RECYCLING OXIDATION SEWAGE TREATMENT,

Othmer, D. F.

Process Biochemistry, Vol. 11, No. 5, p 8-10, 17, June, 1976. 1 fig, 5 ref.

Oxidation of wastes is due to strictly chemical action, enzymatic action, and biochemical action. Both biochemical and enzymatic influences on oxidation are lost at temperatures much above the ambient, but the chemical action is substantially increased at high temperatures and pressures. A number of considerations favor the use of oxygen or oxygen-enriched air in the aerobic digestion of sewage waters. In the best known system using oxygen at atmospheric pressures, several covered conventional aerated digestor tanks are connected for liquid flow and for gas flow in the space above the liquid. Several sewage treatment systems have been used which use increased pressure to dissolve oxygen from air more rapidly. In an improved method using higher pressures, the pressurized waste waters are depressurized after using the oxygen dissolved in them, releasing other dissolved gases. More oxygen is then dissolved by pressurizing the waste waters again with air or oxygen. In one system that can be used for this pressure-recycling oxidation sewage treatment, the aerated influent sewage enters the inner cylinder which also acts as a digester for the organics. The liquid overflows the top of the inner cylinder, and, in the space outside the cone, flocculation and settling of solids and clarification of the liquid take place. This system may act as a complete sewage treatment plant, especially in small sizes. It may also be incorporated with other conventional equipment and processing in larger industrial or municipal plants.

*Waste water treatment, *Sewage treatment, *Sewerage, *Treatment facilities, *Digestion, Waste water (pollution), Liquid wastes, Oxygen, High pressure, Recycling, Oxidation

D287
BULKING CONTROL MADE EASY - WITH HYDROGEN PEROXIDE,

Strunk, W. G., and Shapiro, J.

Water and Pollution Control, Vol. 114, No. 7, p 10, 12, 14, 15, 40-41, July, 1976.

A visual means for predicting potential bulking situations with activated sludge systems and for pinpointing the time at which hydrogen peroxide treatment should begin is described. Sludge bulking involves failure of the sludge to settle adequately, with suspended solids passing out with the effluent. This is most frequently caused by the growth of filamentous bacteria which are susceptible to oxidative attack by hydrogen peroxide. When bulking is imminent, changes occur in the animal and bacterial life in the sludge that can be observed by microscope. Filamentous bacteria can be seen at 100 power magnification when bulking is imminent but are rare in a sludge which compacts and settles readily. Protozoa are also easily observed at 100 power magnification and are the best index of the health of activated sludge. Microscopic observations of four distinct stages of microbiological activity as sludge goes from a healthy state, through incipient bulking, to full bulking, and back to the healthy state are described. Corrective action with hydrogen peroxide is recommended as soon as the initial growth of filamentous bacteria is observed.

*Analytical techniques, *Activated sludge, *Microenvironment, *Microscopy, *Microbiology, Bacteria, Protozoa, Microorganisms, Waste treatment, Oxidation

Hydrogen peroxide, Sludge bulking

D288
U.S. ARMY MOBILITY EQUIPMENT RESEARCH AND DEVELOPMENT COMMAND
ENVIRONMENTAL POLLUTION ABATEMENT PROGRAM,

Schmitt, R. P., and Carnahan, R. P.

Industrial Water Engineering, Vol. 13, No. 1, p 25-26, February/March, 1976.

The United States Army Mobility Equipment Research and Development Command's program in water and waste management is reviewed. The program includes the research and development of water supply systems for the production of potable water, systems for the storage and distribution of water, well drilling equipment, equipment for the collection and treatment of waste water designed for reuse and/or disposal, portable incinerators, and watercraft for waste treatment. Specific projects underway include: the development of reverse osmosis units for the desalination of brackish and sea water, studies of the destruction of bio-refractory organic compounds in water using ozonolysis catalyzed with ultraviolet light, the development of a carbon/polymer treatment process for reclaiming laundry waste water, the identification of trace organics in water, and the development of a land use modeling program aimed at determining the most economical and environmentally compatible use of land at military facilities.

*Waste water treatment, *Reclamation, *Pollutant identification, *Model studies, *Programs, Federal government, Desalination, Sea water, Brackish water, Ozone, Ultraviolet radiation, Organic compounds, Industrial wastes, Land use, Economics, Analytical techniques, Polymers, Reverse osmosis

D289

RECENT DEVELOPMENTS IN SEWAGE TREATMENT AND EQUIPMENT,

Thompson, G. E., and Maguet, G. J.

Water and Pollution Control, Vol. 114, No. 7, p 28, 30-33, July, 1976. 5 fig, 9 ref.

Improvements in sewage treatment methods and equipment are reviewed. Improved tank designs for primary clarification have resulted in increased organics removal and virtual elimination of short circuiting. The use of pure oxygen instead of air in biological treatment schemes is a process improvement which is typified by low retention times, excellent removal efficiencies, and excellent sludge characteristics. The use of deep tanks (up to 22 ft) in activated sludge processes has resulted in transfer efficiencies up to 100% greater than those previously achieved with virtually identical aeration equipment. The rotating biological contactor, which is a modification of the trickling filter process, is typified by extremely low power requirements and excellent reaction to shocking. Physico-chemical treatment processes involving waste water treatment with chemicals such as lime, alum, and ferric chloride are compact and provide high-grade treatment. The introduction of the nitrification-denitrification step into the treatment of waste water for nutrient removal represents a new process addition to the sewage treatment plant. Other new treatment processes in the field of disinfection include: ozonation, bromination, and gamma radiation.

*Waste water treatment, *Sewage treatment, *Biological treatment, *Physical control, *Activated sludge, *Disinfection, Trickling filters, Lime, Iron compounds, Chlorides, Nitrification, Denitrification, Ozone, Radiation, Efficiencies, Equipment, Performance, Gamma rays

Rotating discs, Alum, Ferric chloride, Physico-chemical treatment, Bromination

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D290

WASTEWATER RESOURCES IN NORTH CENTRAL TEXAS,

Horsefield, D. R., and Goff, J. D.

Camp Dresser and McKee, Incorporated,
Boston, Massachusetts.

American Water Works Association Journal, Vol. 68, No. 7, p 357-359, July, 1976.

The feasibility and desirability of waste water reclamation in North Central Texas are discussed. A review of various water reuse alternatives for the area indicates that the steam electric power industry is a potentially large user of reclaimed waste water. Cooling water requirements for the 11 major power plants in North Central Texas amount to an estimated 56 million gallons/day based on the present utilization of cooling towers and lakes, and water requirements are expected to more than double within the next 10 years. By the year 2000, water requirements based on existing cooling technology are expected to be a major problem for the power industry. Thus, the locating of new power plants near municipal waste water facilities so that high quality effluent can be used for cooling towers is recommended.

*Water reuse, *Reclamation, *Reclaimed water, *Municipal wastes, *Cooling water, *Electric power industry, Treatment facilities, Water requirements, Texas, Symbiosis

D291
POWDERED ACTIVATED CARBON IMPROVES ANAEROBIC DIGESTION,

Hunsicker, M., and Almeida, T.

Norristown Sewage Treatment Plant,
Norristown, Pennsylvania.

Water and Sewage Works, Vol. 123, No. 7, p 62-63, July, 1976. 1 fig.

The use of powdered activated carbon to improve anaerobic digestion at a sewage treatment plant is described. Starting with an initial slug of 1800 pounds of activated carbon to each primary digester, followed by a dose of 350 pounds/day thereafter, improved supernatant quality and increased gas production were observed a month after application. Prior to carbon use, relatively poor supernatant clarity limited the amount of raw sludge that could be added to the digesters to about 33,000 gallons/day. After carbon addition twice this volume was drawn while still returning a cleaner supernatant to the pre-aeration chamber. Plant odors are also reduced. Secondary effluent quality is more uniform than it is prior to carbon addition and is meeting all applicable standards. The cost incurred in purchasing the activated carbon has been far offset by savings resulting from the elimination of deodorant chemicals at the plant.

*Activated carbon, *Sewage treatment, *Digestion tanks, *Treatment facilities, Odor, Costs, Performance, On-site tests, Evaluation, Digestion, Sludge

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D292
SLUDGE DRYING BEDS ARE PRACTICAL,

Beardsley, J. A.

Water and Sewage Works, Vol. 123, No. 7, p 82-84, July, 1976.

The use of new designs and chemical treatment for reducing the space and labor required by sludge drying beds is discussed. Two distinct improved designs for sludge drying beds are emerging. The first is a full sand bed with the underdrain system improved so that the clay tile is not crushed by the weight of an end loader. Strong perforated plastic drainpipe or some other means can be used to protect the tile from the load. The second design involves alternating sand and cement strips, with the latter being spaced at wheel distances for the end loader. Provisions for draining surface water can be incorporated at intervals in the bed wall so that rainwater or free water released by chemical treatment may be quickly drained off. This is particularly important in modifying existing hard-bottom beds to optimize chemical use.

*Sludge treatment, *Dewatering, *Design criteria, *Drainage systems, Pipelines, Drying, Waste treatment, Materials, Performance

D293
POLYMERS PLAY INCREASED ROLE IN WATER CLARIFICATION,

Morrow, J. J.

Water and Sewage Works, Vol. 123, No. 7, p 78-81, July, 1976. 5 fig, 2 tab.

The use of synthetic organic polymers in operations involving solids/liquid separation is discussed. The applications of synthetic organic polymers range from the treatment of surface waters to the removal of suspended solids from the final clarifiers of municipal and industrial waste treatment plants. These polymers have also become instrumental in the development of new treatment applications such as direct filtration and high energy mixing. The high performance of synthetic organic polymers is attributed to their high molecular weights and the variety of electrically charged groups that can be placed along the polymer chain. Cationic polymers, for example, can be used in place of alum and lime for primary coagulation, with the result being a significant reduction in the volume and cost of treatment chemicals. Direct filtration with polymers is a treatment method being employed by an increasing number of municipal water systems. The polymers are applied as primary coagulants directly to the raw water source; after rapid mixing, the water is filtered without the benefits of flocculation and sedimentation.

*Polymers, *Separation techniques, *Waste water treatment, *Coagulation, *Filtration, Ions, Municipal wastes, Industrial wastes, Performance, Economics, Suspended solids

Synthetic organic polymers

D294
ECOLOGICALLY BALANCED COMMUNITY WASTEWATER DISPOSAL SYSTEMS
MANAGEMENT FOR DEVELOPING COUNTRIES,

Chaudhuri, N., and Basu, A.

Journal of the Institution of Engineers (India), Vol. 56, Pt. EN2, p 71-75, February, 1976. 5 fig, 7 tab, 7 ref.

A water reclamation management program for urban centers in India is proposed. The program involves the use of stabilization lagoons for waste water treatment, the use of primary sludge as fertilizer in surrounding greenbelt areas, and the conversion of algae into fish protein through pisciculture. Cost estimates for both stabilization lagoons and bio-filters are presented for urban communities in India and indicate that the use of lagoons reduces the treatment costs by two-thirds and saves 185 megawatts of power. The proposed reclamation system is land-intensive, requiring 3.24 hectares for primary and secondary lagoons, 1.21 hectares for pisciculture and recreation, and 17.82 hectares for land treatment in order to reclaim 4.54 million liters/day of waste water.

*Reclamation, *Reclaimed water, *Waste water treatment, *India, *Cities, Programs, Economics, Lagoons, Sludge, Fish farming, Fertilizers, Land use, Symbiosis

D295

IS NUTRIENT REMOVAL WORTHWHILE,

Bachmann, R. W., and Jones, J. R.

Iowa State University,
Ames,
Department of Animal Ecology.

Water and Wastes Engineering, Vol. 13, No. 2, p 14-16, February, 1976. 2 fig.

An objective basis for evaluating the potential benefits of removing nutrients from waste water to prevent eutrophication of surface waters is presented. The initial step in the process is to determine whether nutrient removal will exert a significant effect on the receiving bodies of water. A semi-empirical equation for determining the concentration of phosphorus in natural lakes is presented to illustrate that the phosphorus concentration is directly proportional to the annual inputs and inversely proportional to the depth of the lake. The magnitude of the reduction in phosphorus load to a given body of water from a nutrient removal program ultimately depends on the relative amounts of phosphorus being contributed to the lake from other sources such as surface runoff and rainfall. A study of 34 streams in Iowa is presented to illustrate that in this case few benefits from nutrient removal at waste water facilities are likely to result because of the relatively heavy loadings from nonpoint sources.

*Waste water treatment, *Nutrients, *Phosphorus, *Lakes, *Evaluation, Mathematical models, Surface waters, Water quality control, Eutrophication

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D296

RECENT ADVANCES IN SLUDGE TREATMENT AND DISPOSAL,

Schroeder, W. H., and Cohen, D. B.

Environment Canada,
Ottowa, Ontario,
Wastewater Technology Center.

Water and Pollution Control, Vol. 114, No. 7, p 15-21, 24-25, 27, 38-39, July, 1976. 10 fig, 3 tab.

Advances in sludge treatment and disposal are reviewed. Topics discussed include: sludge stabilization, conditioning, dewatering, drying, and reduction; the use of treated sludge as a fertilizer and soil improvement agent; land reclamation uses; landfill disposal; energy and resource recovery processes; ocean disposal; and underground storage and disposal of sludge. Anaerobic digestion is receiving renewed interest because of the potential benefits of methane production, new design alternatives based on kinetic models, and the present emphasis on land application of digested sludge. However, anaerobically digested mixtures often produce supernatant recycle which is high in biochemical oxygen demand and suspended solids. A recent advance in anaerobic digestion involves thermophilic operation of the digesters as compared to operation in the mesophilic range.

*Sludge treatment, *Sludge disposal, *Reclamation, *Byproducts, Waste disposal, Biochemical oxygen demand, Suspended solids, Biological treatment, Waste storage, Waste treatment, Dewatering, Drying, Fertilizers

*Literature reviews

D297

SAN DIEGO: CIVIL ENGINEERING INNOVATIONS ABOUND,

Civil Engineering-ASCE, Vol. 46, No. 2, p 68-73, February, 1976. 1 fig, 1 tab.

Plans for upgrading municipal sewage treatment in San Diego are discussed. Presently, San Diego's municipal sewage receives only primary treatment, with discharge being to the Pacific Ocean through a 2-mile outfall sewer. Current plans call for sticking with primary treatment but increasing the plant capacity to provide full primary treatment of the higher-than-design flows now being treated. The usefulness of upgrading to secondary treatment is questionable since 12 years of monitoring data indicate that the impact of treatment plant discharges on ocean life is not acute. Eventually, the city plans to upgrade to tertiary treatment and recycle the tertiary effluent. Uncertainties concerning the effects of heavy metals and viruses on people, however, call for a cautious approach in terms of recycling treated water back to the water supply system. Consideration is also being given to the possible practice of aquaculture around sewage outfalls.

*Sewage treatment, *Treatment facilities, *Municipal wastes, *Pacific ocean, Tertiary treatment, Water pollution effects, California, Cities, Water reuse, Recycling, Planning, Aquiculture, Heavy metals, Viruses

San Diego (Calif)

D298

NITROGEN REMOVAL DEPENDS ON FORM NUTRIENT TAKES,

Behrman, B. W.

Metcalf and Eddy,
Boston, Massachusetts.

Water and Wastes Engineering, Vol. 13, No. 2, p 27-29, 46, February, 1976. 1 fig.

Methods for the removal of organic and inorganic forms of nitrogen from waste water are reviewed. Nitrification can be used in conjunction with activated sludge systems or attached growth systems consisting of trickling filters or rotating discs for the removal of organic forms of nitrogen. Biological nitrification processes may be used either with or without coexisting denitrification facilities, depending on the degree of nitrogen removal that is required. If a high degree of denitrification is required, a readily oxidizable source of organic matter must be utilized to provide energy for the denitrifying bacteria. Biological nitrogen control can also be accomplished by the use of land application of waste water; however, consistent removals may not be practical using this method. Nitrogen may also be removed from waste water by harvesting algae which have assimilated soluble and colloidal forms of nitrogen into their cells in a stabilization pond. Physical-chemical nitrogen removal processes include ammonia stripping, breakpoint chlorination, and selective (ammonium) ion exchange. However, none of these processes is capable of removing nitrogen in the organic, nitrite, or nitrate forms.

*Waste water treatment, *Nitrogen, *Biological treatment, *Physical control, Nitrification, Denitrification, Activated sludge, Trickling filters, Algae, Chemical reactions, Ion exchange, Nitrates, Nitrites, Bacteria

Ammonia stripping, Land application, Breakpoint chlorination

D299
NEW ACTON GRANGE WORKS,

Effluent and Water Treatment Journal, Vol. 16, No. 5, p 248-250, May, 1976.
1 fig.

A new sewage treatment facility in the United Kingdom is described. The new facility is an activated sludge type and is designed to produce a final effluent meeting the Royal Commission Standard. The facility will serve both existing and proposed needs within the parishes of Appleton, Grappenhall and Thelwall, Stockton Heath, Stretton, Halton, and Walton. The preliminary treatment consists of the use of curved bar screens; solids deposited on the screens pass through a disintegrator and return to the flow and then go to detritors that automatically remove any grit. Any flows which are greater than three times that of the normal anticipated dry weather flow pass over an overflow weir into storm water balancing tanks for retention and subsequent treatment. The remaining sewage flows to primary settling tanks, aeration tanks, and final settling tanks before biological treatment. Sludge from the primary tanks is pumped into sludge holding tanks for up to 28 days retention.

*Sewage treatment, *Treatment facilities, *Activated sludge, *Biological treatment, Aeration, Sludge treatment, Weirs, Retention, Flow control

Great Britain

D300
OXYGEN FOR EFFLUENT TREATMENT,

Water Services, Vol. 80, No. 964, p 379-380, June, 1976. 2 fig.

The use of oxygen injection for improving effluent treatment is discussed. Two oxygenation systems currently available are described. In one of these systems, bubbles are generated by introducing oxygen in fine bubble form using a high pressure stream of liquor. When the water and gas enter a sludge tank through expansion nozzles, the already small bubbles are shattered into millions of quickly dissolving micro-bubbles. The other system is a bell-shaped diffusor which achieves highly efficient dissolution by maintaining a suspension of bubbles in a flowing column of liquor contained within an open based bell. The varying velocities of the liquor ensure retention of bubbles of all useful sizes, thus enabling virtually total oxygen dissolution. Both systems are useful for preventing anaerobicity in activated sludge systems and thus avoiding sludge death and subsequent sludge bulking.

*Oxygenation, *Activated sludge, *Waste water treatment, *Bubbles, Equipment, Treatment facilities, Performance, Waste treatment, Liquid wastes, Biological treatment

Sludge bulking

D301

WASTEWATER TREATMENT BY REVERSE OSMOSIS,

Shimozato, A., Takahashi, S., Koike, Y., Ebara, K., and
Komori, S.

Hitachi Review, Vol. 25, No. 4, p 147-152, 1976. 6 fig, 5 tab, 1 ref.

Experiments dealing with membrane scale prevention during waste water treatment with reverse osmosis are reported. An automatic continuous ball cleaning system was developed which permits membrane cleaning during operation. The ball cleaning method involves passing sponge balls through the system for impact with the membrane and for promoting turbulent flow. Although adequate for the prevention of soft scale, it was found necessary to combine ball cleaning with chemical treatment for the prevention of hard scale. A combined chemical and ball cleaning system was operated continuously for 1500 hours and demonstrated both effectiveness and reliability. The application of reverse osmosis to closed system waste water treatment is illustrated for the electronics industry. The use of electrodialysis and evaporation in closed system treatment is also discussed.

*Reverse osmosis, *Scaling, *Waste water treatment, *Water reuse, *Reclaimed water, Reclamation, Industrial wastes, Symbiosis, Membranes, Automation, Design criteria, Recycling, Cleaning, Evaporation, Electrodialysis

D302

WASTEWATER PLANT DESIGN REDUCES OFF-SITE ENERGY NEEDS,

Water and Sewage Works, Vol. 123, No. 2, p 41-43, February, 1976. 3 fig.

A waste water treatment plant design that minimizes off-site energy requirements is described. The design is expected to result in a projected savings of $3594 in heating oil and $875 in electricity annually by the integrated use of solar collectors, heat pumps, a small building shell, and basic concrete materials. Methane gas produced by the plant's waste treatment process and an electric generator will provide energy on cloudy days. The process design flow is for 450,000 gallons of sanitary sewage/day. Treatment is to be primary and secondary, including screening, bacteria-nutrient-oxygen-interfacing, settlement, and sludge digestion. The effluents will consist of chlorinated water and dewatered sludge. The plant is designed to service a community of 4200 residents.

*Waste water treatment, *Treatment facilities, *Design criteria, *Energy conversion, *Economics, Conservation, Municipal wastes, Sludge treatment, Methane, Sewage treatment

D303
AUTOMATIC HIGH DENSITY SLUDGE DISCHARGE CONTROL USING ULTRASONICS,

Water Services, Vol. 80, No. 964, p 372, June, 1976. 2 fig.

A high density sludge discharge controller which uses ultrasonics to automatically detect the level and density of raw sludge being transferred to digester or disposal systems and to minimize unwanted transfer of waste water is described. The sludge density controller which consists of a glass-lined pipe section fitted with two ultrasonic crystal sensors is installed in the sludge outlet line. The control unit may be mounted on the pipe section or located at a remote site. The plant process timer starts the transfer of sludge in accordance with a preset schedule by operating a pump or motorized valve. An external delay timer of several minutes duration overrides the function of the sludge density controller until the pipe is clear of low density sludge from the previous transfer cycle. Thick sludge then passes to the digester until the sludge density controller detects a decrease in the percentage of solids being transferred. When the decreased percentage of solids continues to remain at less than the set point for more than 10 seconds, the sludge density controller operates to shut off the pump or valve. A sludge level control may also be incorporated into the system to detect and control the sludge level in settling tanks.

*Waste water treatment, *Sludge, *Automatic control, *Automation, *Density, Equipment, Ultrasonics, Electrical equipment, Flow

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D304
SEWAGE EFFLUENT TURNED TO SNOW: PROVIDES STORAGE, REMOVES POLLUTANTS,

Wright, K. R.

Wright-McLaughlin Engineers,
Denver, Colorado.

Civil Engineering-ASCE, Vol. 46, No. 5, p 88-89, May, 1976. 1 tab.

The feasibility of making artificial snow from secondary treated sewage effluent was investigated as part of an effort to meet specific sewage pollutant load allocations for a treatment facility discharging into a cold water fishery. Conventional snowmaking guns were used to convert sewage effluent into a snow with a physical appearance similar to that of natural snow except for a slightly off-white color. There was no noticeable odor from the waste water snowpack. After about 2 months of storage, fecal coliform bacteria concentrations within the snowpack were generally well within the limits for an A classical stream (less than 200/100 milliliters). Total suspended solids and biochemical oxygen demand after the same period showed decreases of 85% and 91%, respectively. Analyses of snowmelt runoff from the waste water snowpack indicated characteristics similar to the snowpack.

*Waste water treatment, *Waste storage, *Snowpacks, *Snowmelt, *Sewage treatment, *Pollution abatement, Odor, Coliforms, Suspended solids, Biochemical oxygen demand, Freezing, Chemical properties, Physical properties

D305

ACTIVATED CARBON ODOR CONTROL SYSTEM,

McGauhey, M. G., and Poltorak, R. L.

Water Pollution Control,
Hagerstown, Maryland.

Public Works, Vol. 107, No. 7, p 47, July, 1976.

An activated carbon system for removing sewage treatment odors resulting from the conversion of two primary clarifiers to sludge thickeners is described. The thickeners are covered with an 80 by 30 foot gabled roof. Pressure gauges are placed on the discharge lines to allow plant operators to adjust the level of air pressure without entering the covered area. A 10 by 10 foot carbon filter building houses a fiberglass reinforced grid which is covered with a polypropylene mesh screen to retain 3000 pounds of granulated activated carbon. A 4000 cubic foot/minute blower draws the gases from the thickeners through the 3-foot bed of carbon where hydrogen sulfide and organic compounds are stripped from the air. An adjacent sludge well is also vented through the filter, correcting an additional odor problem. Equipment and component system costs amount to about $15,000.

*Activated carbon, *Odor, *Sludge, *Sewage treatment, Hydrogen sulfide, Organic compounds, Treatment facilities, Equipment, Costs

D306

AWT PLANT BEGINS OPERATIONS,

Public Works, Vol. 107, No. 8, p 104, August, 1976.

An advanced waste water treatment plant owned by the Metropolitan Sanitary District of Greater Chicago is described. Plant design is based on a biological nitrification-denitrification process. A two-stage activated sludge treatment process is used to convert ammonia to nitrites and nitrates which eventually are released as nitrogen gas after the addition of methanol to assist the biological reaction. The resulting effluent is so low in oxygen demand, suspended solids, and viral and bacterial content that it meets all national pure water policy criteria and allows for downstream recreational uses. The facility will treat 50 million gallons/day of waste water from the Chicago suburbs of Schaumberg and Palatine as well as provide primary treatment and chlorination for approximately 100 million gallons/day of combined storm and sewage overflows before discharge to Salt Creek.

*Tertiary treatment, *Waste water treatment, *Reclamation, *Reclaimed water, *Treatment facilities, Activated sludge, Nitrification, Denitrification, Bacteria, Viruses, Suspended solids, Oxygen demand, Chlorination, Sewage, Storm water, Illinois, Municipal wastes, Cities, Ammonia, Nitrates, Nitrites, Nitrogen

Chicago

D307
WATER-REUSE SYSTEMS STAR AT CINCINNATI AICHE MEETING,

Ricci, L. J.

Chemical Engineering, Vol. 83, No. 15, p 86, 88, July 19, 1976. 1 fig.

Laboratory and pilot-scale developments in water reuse systems are reviewed. A new pilot-scale scale system that renovates organic chemical-laden waste water for reuse in manufacturing operations is described that combines activated sludge treatment, physical/chemical treatment, reverse osmosis, and primary and secondary ion exchange. Another pilot unit has demonstrated the effectiveness of ultrafiltration for concentrating dilute latex waste waters for reuse. Laboratory studies have determined that certain natural and synthetic adsorbents are effective for removing leachate contaminants from various industrial sludges. The adsorption materials include fly ash, bottom ash, zeolite, vermiculite, illite, kaolinite, cullite, activated carbon, and activated alumina. Other laboratory studies have shown that flue gas desulfurization gypsum sludges hold potential as efficient removers of phosphorus from waste waters. However, undesirable contaminants such as sulfates in the sludge solubilize in the waste water and may cause environmental problems.

*Water reuse, *Reclaimed water, *Waste water treatment, *Reclamation, *Symbiosis, Activated sludge, Reverse osmosis, Filtration, Adsorption, Ion exchange, Sludge, Industrial wastes, Phosphorus, Pilot plants, Organic compounds, Chemical wastes

Ultrafiltration

D308
CROSS-FLOW FILTRATION IN PHYSICAL-CHEMICAL TREATMENT
OF MUNICIPAL SEWAGE EFFLUENTS,

Mahlman, H. A., Sisson, W. G., Kraus, K. A., and Johnson, J. S., Jr.

Oak Ridge National Laboratory,
Oak Ridge, Tennessee,
Water Research Program.

February, 1976. 127 p, 54 fig, 11 tab, 38 ref. Technical Report EPA-600/2-76-025.

Exploratory investigations were performed on the use of cross-flow filtration of primary and secondary municipal sewage effluents. In this approach, the solution being filtered is pumped parallel to the filter. Thickening of flux-limiting filtercake is slowed, and the original stream is separated into a large volume of filtrate and a concentrated slurry of solids. The effects of pressure, circulation velocity, additive concentration, water recovery, pH, and other variables were investigated. Filtrate from primary effluent treated with iron or aluminum salts, with powdered activated carbon (PAC), or with both hydrolyzable ions and PAC, was generally of quality superior in turbidity, organic carbon, and other respects to the effluent from biological secondary treatment. Turbidities were usually well below 1 JTU; bacteria were substantially removed. With iron or aluminum salts, filtrate total organic carbon (TOC) typically was 10 to 15 mg/liter, and phosphate below one mg/liter. With PAC, TOC was usually about 5 mg/liter, but phosphate removal was poor. With about 0.001 M iron(III) average fluxes of about 6 m/d appear attainable at 4.6 m/sec circulation velocity with 24 hr backwash intervals. When feed is activated sludge secondary effluent, fluxes and product characteristics are similar, except that TOC is lower. With iron or aluminum salts, unless pH is adjusted to the neutral range before filtration, filtrate is substantially contaminated with the salts. An effluent low in phosphate and TOC was obtained by second-stage filtration of primary sewage filtrate treated with PAC and hydrolyzable ions.

D309
REVIEW OF THE MUNICIPAL WASTE WATER TREATMENT WORKS PROGRAM,

November 30, 1974. 93 p, 1 fig, 23 tab, 1 append. Technical Report PB-244 923.

The grants program for construction of municipal waste water treatment facilities is reviewed. An adequate program is defined. The many requirements were aggregated into the principal goal of achieving the most cost-effective abatement of municipal waste water pollution through the proper planning, design, construction, and operation of treatment works. This goal includes five subgoals: managing the program efficiently and with sufficient resources for adequate performance, ensuring that projects are constructed in a timely manner by expeditiously obligating funds, ensuring the environmental soundness of the projects by managing the environmental impact statement process effectively, detecting and deterring fraud and other irregularities, and protecting the responsibilities of the states in water pollution control. Cost-effectiveness is defined as including social, environmental, and non-monetary costs. One possible strategy summarizes the manpower requirements of the adequate strategy. It would permit a relatively high achievement of the cost-effectiveness goal and its subgoals. A second possible strategy would require less staff but could seriously sacrifice achievement of program goals. Two other possible strategies would reduce federal staffing needs, but would increase those of the states through the delegation of additional responsibilities.

*Waste water treatment, *Treatment facilities, *Waste water (pollution), *Waste treatment, *Programs, Municipal wastes, Grants, Construction

*Waste water treatment works program

D310
REGIONAL WASTEWATER SOLIDS MANAGEMENT PROGRAM
LOS ANGELES-ORANGE COUNTY METROPOLITAN AREA,

Burack, D.

Los Angeles-Orange County Sludge Program,
Whittier, California.

In: Proceedings of the 1975 National Conference on Municipal Sludge Management and Disposal, August 18-20, 1975, Anaheim, California, p 26-29. 4 fig.

A regional waste water sludge management program for the Los Angeles-Orange County metropolitan area is described. The program is to be conducted under a Joint Powers Agreement by the three major waste water agencies in the region with the assistance of the State of California and the United States Environmental Protection Agency. The following disposal or recycling alternatives will be studied: recycling of waste water solids for agricultural uses, soil reclamation, and use as soil supplement; disposal of waste water solids to land; waste water solids disposal to the ocean; incineration and pyrolysis processes for volume reduction and resource recovery; and conditioning, dewatering, and composting. In conjunction with these alternatives, transportation and sludge processing as well as the disposal of industrial sludges will also be studied.

*Sludge disposal, *Sludge treatment, *Recycling, *Programs, *Governmental interrelations, Waste disposal, Reclamation, Incineration, Dewatering, Byproducts, Solid wastes, Municipal wastes, California, Industrial wastes, Transportation

Pyrolysis, Los Angeles, Orange County

D311

SLUDGE MANAGEMENT ALTERNATIVES FOR COASTAL CITIES,

Bursztynsky, T., and Davis, J.

Engineering-Science, Incorporated,
Berkeley, California.

In: Proceedings of the 1975 National Conference on Municipal Sludge Management and Disposal, August 18-20, 1975, Anaheim, California, p 65-72. 13 tab, 7 ref.

Findings from a study of seven alternative sludge disposal options for the Southern California coastal area are summarized. Ocean disposal appears to be the least cost option by a wide margin, and its total abandonment is considered a misallocation of resources unless the environmental impact is clearly demonstrated to be greater than that of more costly alternatives. Composting for sale appears to be the most desirable method of sludge management on an overall basis. Environmental risks are minimized and some benefits are realized. The system has good public acceptability, land use compatibility, ease of implementation, and financial feasibility. To a large extent this is the system being employed at Los Angeles and Orange Counties, indicating that natural selection processes of public pressure, economic considerations, and environmental awareness have been at work. Detailed breakdowns of environmental, feasibility, performance, and economic factors are presented for the various sludge management alternatives considered.

*Sludge disposal, *Municipal wastes, *Cost-benefit analysis, *Reclamation, *Social aspects, Economics, Waste disposal, Oceans, Feasibility studies, California

Ocean disposal

D312

BY-PRODUCT SOLIDS MANAGEMENT ALTERNATIVES CONSIDERED FOR PHILADELPHIA,

Ballotti, E. F., and Wilson, T. E.

Greeley and Hansen,
Chicago, Illinois.

In: Proceedings of the 1975 National Conference on Municipal Sludge Management and Disposal, August 18-20, 1975, Anaheim, California, p 73-79. 7 tab, 1 ref.

Alternative methods of managing byproduct solids generated by waste water treatment plants in the Philadelphia area are discussed. Biological processes generally rank better than physical-chemical processes from a cost, energy, and nutrient utilization standpoint. A number of land disposal alternatives utilizing anaerobically digested solids appear to have potential as acceptable management programs; however, it does not appear that a land disposal alternative is feasible for the total amount of solids removed in Philadelphia. The sea dispersal alternative, also utilizing anaerobic digestion as the stabilization process, has proven to be simple, economical, and easily controlled. Preliminary feasibility studies on an anhydrous and liquid ammonia alternative appear promosing. This alternative utilizes anaerobic digestion and converts excess digestion gas to the form of fertilizer commonly used for crop fertilization in the United States.

*Municipal wastes, *Solid wastes, *Waste water treatment, *Waste disposal, *Reclamation, Economics, Biological treatment, Byproducts, Fertilizers, Pennsylvania

Philadelphia

D313

SLUDGE DISPOSAL ALTERNATIVES FOR BOSTON,

Simpson, G. D.

Havens and Emerson, Limited,
Cleveland, Ohio.

In: Proceedings of the 1975 National Conference on Municipal Sludge Management and Disposal, August 18-20, 1975, Anaheim, California, p 80-85. 1 fig, 5 tab, 5 ref.

Findings from a study of sludge disposal alternatives for the city of Boston are presented. Among three final alternatives considered (land application, dewatering and incineration, and wet oxidation), dewatering and incineration is the least cost option, being lower in capital cost than the nearest alternative by about $7.6 million and lower in total annual cost by about $1.6 million/year. From environmental and other non-cost standpoints, incineration rates are equal to or better than the other two alternatives in seven of nine categories; whereas land application rates are equal to or better than the other two alternatives in only three of nine categories. Based on the above findings, a detailed project plan is proposed for chemically conditioning, vacuum filtering, and incinerating sludge from Boston's waste water treatment plants. Incinerator ash will be utilized for landfill to provide additional space required for a future secondary treatment plant. Ash leachate will be collected and recycled to treatment.

*Sludge disposal, *Municipal wastes, *Incineration, *Cost-benefit analysis, *Dewatering, Reclamation, Byproducts, Programs, Waste water treatment, Massachusetts, Waste disposal, Land use, Feasibility studies

Boston

D314

ENERGY CONSERVATION PRACTICES IN MUNICIPAL SLUDGE MANAGEMENT,

Miller, G. W.

Public Technology, Incorporated,
Washington, D. C.

In: Proceedings of the 1975 National Conference on Municipal Sludge Management and Disposal, August 18-20, 1975, Anaheim, California, p 91-100. 2 fig, 6 tab, 21 ref.

Municipal inventories of energy consumption associated with waste water treatment and sludge management are reviewed in relation to conserving energy in such operations. Energy consumption in waste water treatment operations in general and for sludge disposal in particular is concluded to be a major consumer in municipal government operations. Larger waste water treatment plants that process sludge by anaerobic digestion can increase the cost-effectiveness of their operations by utilizing all of the digester gas. The digester gas can be used directly to operate equipment, can be used to generate electricity, or can be sold for commercial or industrial use. It is usually not practical to sell the methane gas produced by digestion if it is possible to utilize all of it within the plant. A detailed cost analysis of the value of retaining digestion when total incineration of raw sludge is possible is presented for a particular facility.

*Sludge treatment, *Waste water treatment, *Municipal wastes, *Cost analysis, *Digestion, Byproducts, Incineration, Conservation, Methane, Energy conversion, Treatment facilities

D315
UPDATING THE 1974 PITTSBURGH CONFERENCE,

Wright, D. R.

Environmental Protection Agency,
Washington, D. C.

In: Proceedings of the 1975 National Conference on Municipal Sludge Management and Disposal, August 18-20, 1975, Anaheim, California, p 101-108.

Summaries of various projects dealing with municipal waste water and sludge treatment are presented. Specific projects discussed include: studies on the interactions between sludge thickening and other sludge treatment and disposal processes; anaerobic digester operation; a comparison of diffused air aerobic digestion with pure oxygen digestion of waste activated sludge; the use of pressure filtration for solids removal; the effectiveness of combining heat treatment, dewatering, and incineration for sludge treatment and disposal; the drying of sludge for marketing as fertilizer; the utilization of digested chemical sewage sludges on agricultural lands; the economics of sludge irrigation; and energy conservation and recycling techniques for waste water treatment plants.

*Municipal wastes, *Waste water treatment, *Sludge treatment, *Sludge disposal, Incineration, Dewatering, Filtration, Digestion, Sewage sludge, Irrigation, Economics, Conservation, Recycling, Treatment facilities, Fertilizers, Drying

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D316
SUMMARY OF THE ASCE SEMINAR ON SLUDGE DISPOSAL,

Robson, C. M.

MCA Engineering Corporation,
Baltimore, Maryland.

In: Proceedings of the 1975 National Conference on Municipal Sludge Management and Disposal, August 18-20, 1975, Anaheim, California, p 109-114. 6 tab, 1 ref.

Summaries of presentations dealing with sludge treatment and disposal delivered at the Second Annual National Conference on Environmental Engineering Research, Development, and Design sponsored by the American Society of Chemical Engineers at the University of Florida on July 21, 1975 are presented. Topics covered include: an overview of sludge handling and disposal, the treatment of sludge processing sidestreams, methods for conserving energy during sludge incineration, the landspreading of liquid municipal sludge, and the treatment of sludge for land disposal. Each summary is supplemented by information provided during subsequent question and answer periods.

*Sludge treatment, *Sludge disposal, *Municipal wastes, *Reclamation, Conservation, Land use, Waste disposal

D317

THE PAST, PRESENT, AND FUTURE PROSPECTS OF BURNING MUNICIPAL SEWAGE SLUDGE ALONG WITH MIXED MUNICIPAL REFUSE,

Smith, E. M., and Daly, A. R.

Roy F. Weston, Incorporated,
West Chester, Pennsylvania.

In: Proceedings of the 1975 National Conference on Municipal Sludge Management and Disposal, August 18-20, 1975, Anaheim, California, p 115-123. 4 fig, 1 tab, 35 ref.

The use of co-incineration for burning municipal sewage sludge along with mixed municipal refuse is discussed in terms of past experience and future prospects. Experience with burning sludge in conventional refractory-wall mixed municipal refuse incinerators indicates that the moisture present in the sewage sludge depresses furnace temperature, thus necessitating reductions in excess air to hold the furnace gas temperature within the desirable range of 1400-1800 F. However, when thickened sludge feed is used, adequate furnace temperatures can not be maintained even with zero excess air. Thus, it is necessary to dewater the sludge to about 20% solids, followed by drying, before the sludge solids are fed to the incinerator. A co-incineration option for the future is the use of conventional sludge incinerators modified to handle shredded and cleansed mixed municipal refuse. Various experimental co-incineration installations presently in operation throughout the world are described.

*Sludge disposal, *Incineration, *Municipal wastes, *Sewage sludge, Treatment facilities, Dewatering, Drying

Co-incineration, Mixed municipal refuse

D318

HIGH ENERGY RADIATION IN SLUDGE TREATMENT - STATUS AND PROSPECTS,

Farrell, J. B.

Environmental Protection Agency,
Cincinnati, Ohio.

In: Proceedings of the 1975 National Conference on Municipal Sludge Management and Disposal, August 18-20, 1975, Anaheim, California, p 124-133. 6 fig, 3 tab, 21 ref.

The use of high energy radiation for treating waste water and sewage sludge is discussed in terms of past experience and future prospects. Experimental work with sewage sludge indicates that highly significant levels of microbial reduction occur at irradiation levels under 1.0 megarad. Cost studies indicate unrealistically high levels for sewage treatment but not necessarily for sludge. Synergistic effects on reductions in microbial levels appear to occur when radiation is combined with chlorine, heat, or zinc chloride. Radiation also reduces the chemical oxygen demand levels for aqueous solutions of certain chemicals at radiation levels less than 0.2 megarad, but much higher levels are required for significant effects with sewage. Radiation treatment apparently improves the settling rate and filterability of sewage sludge, although the effect is not large. Future prospects for improving radiation effectiveness hinge around the effect of oxygen addition, although this approach may be limited by the solubility of oxygen in sludge. There is also the possibility of irradiating raw sludge for subsequent disposal into the ocean or for landspreading purposes. Major research programs dealing with radiation treatment of wastes are outlined.

*Radiation, *Waste water treatment, *Sludge treatment, *Sewage, Microorganisms, Chemical oxygen demand, Economics, Chlorine, Oxygen, Heat, Waste treatment, Sewage sludge, Chlorides

D319
MANAGEMENT OF MUNICIPAL WASTEWATER TREATMENT RESIDUALS,

Bryan, E. H.

National Science Foundation,
Washington, D. C.

In: Proceedings of the 1975 National Conference on Municipal Sludge Management and Disposal, August 18-20, 1975, Anaheim, California, p 134-138.

Research projects sponsored by the National Science Foundation and dealing with the management of municipal waste water treatment residuals are reviewed. The projects involve the following: the design of a tractor-implement for injecting sludge into soil at a rate of up to 800 gallons/minute; the development of an analytical model of subsurface injection; the potential use of high-energy electrons for the disinfection of municipal waste water treatment residuals; the extent of virus survival in soils subjected to municipal sludge application; the control of virus pathogens by irradiation; the process selection for optimum management of regional waste water treatment residuals; the potential utilization of wetlands for their ability to remove nutrients from domestic waste water that has received secondary treatment; the use of simulation to provide a better understanding of water, nutrient, and general ecosystem functions; the use of injection wells for industrial waste management; and the relationships between regionalization of waste water systems and economies of scale.

*Waste water treatment, *Sludge treatment, *Research priorities, *Municipal wastes, Model studies, Injection wells, Radiation, Viruses, Nutrients, Management, Simulation analysis, Domestic wastes, Industrial wastes, Economics, Land use

D320
PYROLYSIS OF SEWAGE SLUDGE,

Olexsey, R. A.

Environmental Protection Agency,
Cincinnati, Ohio.

In: Proceedings of the 1975 National Conference on Municipal Sludge Management and Disposal, August 18-20, 1975, Anaheim, California, p 139-145. 4 fig, 6 tab, 13 ref.

The feasibility of using pyrolysis for sewage sludge disposal is discussed along with some preliminary findings from pilot-scale tests conducted by the Environmental Protection Agency and the Bureau of Mines. Pyrolysis is the destructive distillation of organic materials under heat and/or pressure in the absence of oxygen. Tests involving the pyrolysis of sludge alone reveal that the process represents a substantial improvement over conventional incineration with respect to fuel consumption and air pollutant emissions. However, the high moisture content of sewage sludge favors the use of a combination of sludge and dry organic material to reduce the energy requirements associated with evaporating the moisture in the sludge. Tests with mixtures of sludge and shredded solid waste indicate that this approach is feasible, although both the environmental aspects and economics of the process require further investigation.

*Sludge disposal, *Sewage sludge, *Organic compounds, *Distillation, Incineration, Waste disposal, Pilot plants, Feasibility studies, Moisture content

Pyrolysis, Refuse

D321

SLUDGE PYROLYSIS FOR ENERGY RECOVERY AND POLLUTION CONTROL,

Lewis, F. M.

Stanford Research Institute,
Menlo Park, California.

In: Proceedings of the 1975 National Conference on Municipal Sludge Management and Disposal, August 18-20, 1975, Anaheim, California, p 146-152. 6 fig, 1 tab, 9 ref.

The use of pyrolysis for sludge decomposition is discussed. Pyrolysis is an irreversible chemical change brought about by the action of heat in an atmosphere devoid of oxygen and offers advantages over conventional incineration in terms of fuel economy, energy recovery (steam generation), and control of heavy metals. An analysis of the thermodynamics of various pyrolysis systems reveals that a proprietary pyrolysis reactor that is indirectly heated by the afterburner flue products requires the least amount of auxiliary fuel. For maximum efficiency in pyrolysis systems, a high solids content in the sludge cake and a low excess air rate are desirable. Techniques are currently available for producing a sludge cake in excess of 40% total solids. The steam generated by a pyrolysis system treating sludge can be used for the generation of electricity or for operation of aerators and pumps at waste water treatment plants.

*Sludge disposal, *Distillation, *Waste treatment, *Energy conversion, *Thermodynamics, Treatment facilities, Heavy metals, Incineration, Economics

Pyrolysis

D322

A SUMMARY OF OBSERVATIONS ON THERMOPHILIC DIGESTER OPERATIONS,

Ohara, G. T., and Colbaugh, J. E.

City of Los Angeles' Hyperion Treatment Plant,
Playa del Ray, California.

In: Proceedings of the 1975 National Conference on Municipal Sludge Management and Disposal, August 18-20, 1975, Anaheim, California, p 218-226. 10 fig, 9 tab, 4 ref.

Observations made while investigating two applications of thermophilic sludge digestion are reported. The applications concern the enhancement of the sludge dewatering process under certain conditions when thermophilically digested sludge is used instead of mesophilically digested sludge and methane gas production during thermophilic digestion in comparison to mesophilic digestion. The investigations were conducted at a Los Angeles treatment plant. Thermophilically digested sludge and a solid bowl centrifuge produced a drier sludge cake, contained less suspended material in the centrate, required less chemical conditioning than mesophilic sludge, and permitted a higher sludge feed rate. This combination was the only one to essentially meet all the dewatering requirements. Heating digesters to 120 F for thermophilic digestion requires 69% more BTUs than heating them to 95 F for mesophilic digestion. There is some evidence that the centrate from thermophilic sludges contains a greater amount of certain dissolved heavy metals. Also, centrate-filtrate from thermophilic sludges contained approximately 30% higher chemical oxygen demand (COD) than mesophilic centrate. Thermophilic bacteria appear more sensitive to loading and temperature changes than mesophilic bacteria. Thermophilic sludges were easier to dewater in some situations. Thermophilic particles are coarser than mesophilic particles. Volatile acid levels are 400-500 mg/liter in thermophilic digestion, compared to 100-200 mg/liter for mesophilic digestion. There is some evidence that methane gas production is higher and gas quality is lower for thermophilic digestion, when compared to mesophilic digestion.

D323
UTILIZATION OF METHANE FROM SLUDGE DIGESTION,

Kapoor, S. K., and Newton, D.

Greeley and Hansen, Engineers,
Chicago, Illinois.

In: Proceedings of the 1975 National Conference on Municipal Sludge Management and Disposal, August 18-20, 1975, Anaheim, California, p 227-234. 3 fig, 1 tab, 27 ref.

Numerous conventional uses of sludge gas are restated and the feasibility of sludge gas utilization for production of chemicals is discussed. It appears that both sludge gas utilization and production should be maximized. Increased energy requirements due to proposed secondary treatment at all plants call for more intensive use of sludge for plant purposes. Historical modes of sludge gas utilization are believed to be the most economical. These include generation of electricity; direct operation of pumps and blowers; and hot water or steam production for space heating, air-conditioning, and digester heating. In-plant storage will help increase utilization by equalizing essentially diurnal fluctuation in supply and demand. In some places, the conventional uses may not be feasible; use of sludge gas to produce ammonia or methanol for in-plant use should be investigated. If applicable, ammonia can be used to fortify sludge for use as soil conditioner or fertilizer. In exceptional cases, sludge gas has been effectively sold to a gas-using industry or utility. Commercial use of sludge gas is likely to become more cost effective as natural gas and other energy sources diminish in supply and become more expensive.

*Waste water treatment, *Treatment facilities, *Methane, *Sludge digestion, Chemicals, Industrial production, Sewage treatment, Economic efficiency, Heating, Storage, Feasibility, Ammonia, Supply

Chemical production, Methanol

D324
HIGHLY ENERGY EFFICIENT-WILTON WASTEWATER
TREATMENT PLANT,

Wilke, D. A., and Fuller, D. R.

Civil Engineering-ASCE, Vol. 46, No. 5, p 70-72, May, 1976. 3 fig.

A highly efficient waste water treatment plant design that minimizes the need for off-site energy requirements is described. The design takes advantage of gravity flow to reduce pumping needs, solar energy to provide heat for the anaerobic digesters, and concrete construction to retain heat for the building itself. Waste water is lifted into the plant by screw pumps which use less energy than conventional pumps and flows through the rest of the plant by gravity. Pretreatment is provided by comminution and grit removal. Gross solids are removed by rotary screens. Secondary biological treatment is accomplished via a rotating biological contactor. Final solids separation is accomplished in clarifiers from which the solids are combined with the primary screenings and pumped to anaerobic digesters for stabilization before dewatering and disposal. Disinfectant for the effluent is generated on-site electrochemically from salt and water. First year energy cost savings are estimated to be $4700.

*Waste water treatment, *Treatment facilities, *Energy conversion, *Economics, Gravity, Solar radiation, Construction, Materials, Concrete construction, Dewatering, Biological treatment, Disinfection, Stabilization, Design

D325

INTERACTIONS BETWEEN SLUDGE CONDITIONING, VACUUM FILTRATION, AND INCINERATION,

Christensen, G. L., Elliott, W. R., and
Johnson, W. K.

Minnesota University,
Minneapolis,
Department of Civil and Mineral Engineering.

Journal of the Water Pollution Control Federation, Vol. 48, No. 8, p 1955-1969, August, 1976. 15 fig, 3 tab, 26 ref.

Laboratory investigations of chemical sludge conditioning, vacuum filtration, and filter cake incineration were conducted. Neither lime nor ferric chloride alone was capable of producing a conditioned sludge suitable for vacuum filtration, even at doses as high as 30% on a dry solids basis. The most effective combination for chemical conditioning was 5% ferric chloride and 15% lime. Specific resistance measurements of sludge dewaterability exhibited considerable scatter, while capillary suction time measurements were quite precise. Nevertheless, specific resistance measurements reflected the improved sludge solids leaf yields associated with increases in ferric chloride and lime doses, whereas capillary suction time measurements did not. The water to sludge solids ratio was of the utmost importance in assessing auxiliary fuel requirements for filter cake incineration.

*Sludge treatment, *Chemical reactions, *Dewatering, *Filtration, *Incineration, Waste treatment, Analytical techniques, Lime, Iron compounds, Chlorides

Ferric chloride, Vacuum filtration

D326

EVALUATION OF A SULFUR-THIOBACILLUS DENITRIFICANS NITRATE REMOVAL SYSTEM,

Sikora, L. J., and Keeney, D. R.

USDA-ARS Agricultural and Environmental Quality Institute,
Beltsville, Maryland,
Biological Waste Management and Soil N Laboratory.

Journal of Environmental Quality, Vol. 5, No. 3, p 298-303, July-September, 1976. 6 fig, 3 tab, 32 ref.

A sulfur-Thiobacillus denitrificans nitrate removal system was evaluated as a means of denitrifying nitrified septic tank effluent. Duplicate 10 by 64 cm columns were filled with a 1/1 mixture (by weight) of elemental sulfur and dolomite chips and were pretreated by recycling an enrichment culture of Thiobacillus denitrificans ATCC 23642 through the columns for 3 days. Continuous passage of the nitrified septic tank effluent containing 40 micrograms of nitrate/milliliter through the columns resulted in nearly complete nitrate removal in 3.3 hours at steady state conditions. The denitrification kinetics appeared to be first order in the range of nitrate concentrations used. Sulfate was the major sulfur end product and was present at relatively high concentrations (90 micrograms/milliliter). Passage of column effluent through 10 by 60 cm Plainfield sand columns did not significantly decrease sulfate levels. A significant decrease in inorganic carbon content occurred with depth in the columns, but changes in organic carbon were insignificant. Although the use of this nitrate removal system appears promising, sulfate contamination of the groundwater may limit its applicability.

*Denitrification, *Septic tanks, *Sewage treatment, *Domestic wastes, *Nitrates, Biological treatment, Bacteria, Sulfates, Groundwater, Sulfur, Carbon, Inorganic compounds, Organic compounds, Waste treatment, Kinetics, Chemical reactions

D327

RAW SEWAGE COAGULATION AND AEROBIC SLUDGE DIGESTION,

Jones, R. H., Burnszytnsky, T. A., and Crane, J. D.

Environmental Science and Engineering, Incorporated,
Gainesville, Florida.

November, 1975. 115 p, 31 fig, 16 tab, 20 ref, 4 append. Technical Report PB-249 107.

The efficiency of chemical coagulation for treatment of raw sewage was studied in laboratory and full-scale investigations at the Hollywood, Florida, sewage treatment plant. The full scale clarifier was unable to duplicate the high treatment efficiencies produced by various polyelectrolytes in laboratory tests, probably due to inadequate mixing and higher soluble biochemical oxygen demand (BOD) concentrations. Primary sludges were successfully digested aerobically with as little as 10 days detention. Aerobic sludge digestion was shown to provide an excellent method of stabilizing primary municipal sewage sludge prior to ultimate disposal. Oxygen uptake rates reached 1.8 gm oxygen/(g T.S.)(hr) for sludge ages greater than 20 days. Alkalinity of aerobically digested sludge was greatly reduced; sludges digested for 15 days or longer had average alkalinities below 200 mg/liter. The pH stabilized at near 7.0. The recommended detention time of 20 days produced a solids content between 4 and 6%; further gravity thickening was not practical. Aerobically digested sludge will dry at a high rate on a sand bed with a good underdrain system, but have little mineral fertilizer value. Aerobically digested sludge experienced substantial reductions of waste constituents upon lagooning.

*Waste water treatment, *Sewage treatment, *Sewerage, *Biochemical oxygen demand, *Treatment facilities, Sludge digestion, Waste treatment, Waste water (pollution), Sludge disposal, Coagulation

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D328

THE LABORATORY EVALUATION OF A METHOD FOR ENHANCING THE KINETICS OF ACTIVATED SLUDGE TREATMENT PLANTS,

Sedita, S. J.

Houston Research, Inc.,
Houston, Texas.

October, 1975. 72 p, 23 fig, 18 tab, 11 ref, 1 append. Technical Report PB-245 683.

The activated sludge process was studied in the laboratory to determine the technical feasibility that disrupting a portion of the microbial cells in the return sludge will enhance the operating efficiency and capacity of municipal activated sludge plants. Activated sludge from a Bellaire, Texas, plant was acclimated to five different test compounds: 2,4-dichlorophenol, linear alkylate sulfonates, nitrilotriacetic acid, ethylene dinitrilotetraacetic acid, and ethylene glycol. The test compounds were then incorporated into waste water influent and fed to the acclimated sludge which had been mechanically disrupted, to varying degrees, by sonic energy. Significant amounts of soluble materials were released from the concentrated sludge in the form of total organic carbon. A significant portion of the microorganisms found in concentrated sludge are killed by sonication. The substrate removal activity of disrupted sonicated sludge is not significantly different from undisrupted sludge having a thousand times the cell concentration, and the cell free supernate from disrupted sludge may have substrate removal activity up to 10 times that of normal sludge. It may be possible to significantly increase throughput capacity by using a combination of normal return sludge and disrupted sludge of supernate.

*Waste water treatment, *Activated sludge, *Sewage treatment, *Organic compounds, *Enzymes, Evaluation, Laboratory tests, Kinetics

*Bacterial extracts

D329

WATER HYACINTHS FOR UPGRADING SEWAGE LAGOONS TO MEET ADVANCED WASTEWATER TREATMENT STANDARDS: PART I.

Wolverton, B. C., and McDonald, R. C.

National Space Technology Laboratories,
Bay St. Louis, Mississippi.

October, 1975. 9 p, 2 tab, 12 ref. Technical Report N76-10697.

Water hyacinths were studied as a means of accomplishing final filtration to remove nutrients, heavy metals, and other chemicals from domestic waste waters. Biweekly grab samples from before and after saturating a secondary domestic sewage lagoon were compared with samples from a control lagoon free of water hyacinths. The water hyacinth-covered lagoon had a surface area of 0.70 acre with a total capacity of 1.5 million gallons, receiving an inflow of 115,000 gallons per day from a 3.8 acre aerated primary sewage lagoon. Retention times varied between 14 and 21 days depending on the water hyacinth evapotranspiration rates. The water hyacinths functioned as an efficient and inexpensive final filtration system in a secondary domestic sewage lagoon during a three month test period. They reduced the suspended solids, biochemical oxygen demanding substances, and other chemical parameters to levels below the state standards. While absorbing organics, nutrients, and other chemical elements from sewage waste, they produced large quantities of plant material. When grown in enriched sewage waste free of heavy metals, this biomass can be harvested and possibly processed into valuable feed products, organic fertilizer and soil conditioner, or methane gas and inorganic fertilizer. The volume of water hyacinths required depends on the amount of sewage to be processed and the desired purity of the final waste water.

*Waste water treatment, *Sewage treatment, *Sewerage, *Biochemical oxygen demand, *Treatment facilities, Water hyacinths, Sewage, Waste water (pollution)

D330

IMPROVED LIQUID-SOLIDS SEPARATION BY AN ALUMINUM COMPOUND IN ACTIVATED SLUDGE TREATMENT,

Lenhart, C. F., and Cagle, J. W.

Nalco Chemical Company,
Oak Brook, Illinois.

September, 1975. 71 p, 34 fig, 3 tab, 9 ref. Technical Report PB-248 228.

A study was undertaken to determine the effects of sodium aluminate additions on the activated sludge waste treatment process. Data were compared for periods with and without chemical dosing. Waste water throughout the study was typical of the normal domestic sewage treated at the plant studied. The only attempts to adjust plant flow or treatment conditions were those necessary to maintain good, efficient waste water treatment operations. It was demonstrated that feeding liquid alkaline alumina to a 2.5 million gal per day activated sludge waste water treatment plant is a practical method of gaining several operational benefits. The increased sludge density permitted the plant to protect itself against solids washout during spot flows greater than 164% of designed plant capacity. Solids handling and ease of sludge volume index control were improved. Aluminate application allowed higher levels of mixed liquor suspended solids to be retained in the secondary clarifier. The improved solids removal with sodium aluminate reduced the loading on the tertiary treatment unit. Additional benefit was noted in the concentration of aerobically digested solids. Phosphorus removal approaching 80% was achieved with feed rates of 10 mg/liter as aluminum. The most efficient point to treat the mixed liquor stream was at the outlet of the primary basin. Residual benefits accrued for 10 days after aluminate feed was stopped. It took from 3 days to a week after starting the aluminate to produce optimum conditions in the secondary clarifier. Improved solids settling occurred within 24 hr of startup. Thicker return sludge resulting from the use of sodium aluminate permitted a substantial reduction in waste activated sludge volumes to be handled.

D331

DEMINERALIZATION OF WASTEWATER BY ELECTRODIALYSIS,

Takenaka, H. H., Chen, C. L., and Miele, R. P.

United States Environmental Protection Agency,
San Francisco, California.

October, 1975. 35 p, 6 fig, 9 tab. Technical Report PB-249 102.

An electrodialysis pilot plant study was carried out to investigate the use of the process for waste water demineralization. The study was conducted using a 12 gpm electrodialysis pilot plant and the carbon-treated secondary effluent of the Pomona activated sludge plant. Stack fouling due to slime occurred whenever an increase in stack pressure was accompanied by a decrease in stack electric current or demineralization. This organic fouling significantly decreased the effectiveness of the process. An enzyme detergent was successful in removing most of the slime on the membranes, however, heavy slime formation in the stack was not removed. If the chemical oxygen demand (COD) of the feedwater remained at 10 mg/liter or less, a weekly enzyme detergent flush maintained the total dissolved solids (TDS) removal in the design range of 30-35%. An acid solution was required after the enzyme detergent flush to remove the detergent and restore the stack amperage. Other forms of fouling, such as membrane scale, were not as serious a problem. An acid solution effectively removed scale formation. The cost to produce water with 30 to 35% TDS reduction in a 10 MGD single stage electrodialysis plant was estimated at about $0.194 per 1,000 gallons of product water, not including the costs of carbon adsorption pretreatment and brine disposal.

*Waste water treatment, *Chemical oxygen demand, *Electrodialysis, *Treatment facilities, *Sewage, Effluents, Membranes, Cost analysis, Waste water (pollution), Activated sludge

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D332

DEMONSTRATION OF A PLANNING PERSPECTIVE FOR WASTE WATER SLUDGE DISPOSITION OHIO/KENTUCKY/INDIANA,

Neptune, M. D., and Toftner, R.

January, 1976. 183 p, 12 fig, 24 tab, 60 ref, 4 append. Technical Report PB-250 684.

Waste water treatment and sludge disposal methods of plants in the Ohio-Kentucky-Indiana region were investigated to test an application of a methodology previously developed by the Environmental Protection Agency. Fifteen of the area's 158 waste water treatment facilities and 3 proposed facilities were selected for evaluation. The sample plants were surveyed by on-site inspection and analysis of available records. Background information is included, such as the region's economic and institutional characteristics and environmental setting, current waste water treatment and sludge management practices, and applicable air and water quality and land use regulations. In application of the methodology, various sludge management alternatives are analyzed in terms of technical feasibility, costs, environmental impacts, sociopolitical implications, and other factors. Each facility is analyzed based on volumes of sludge generated, characteristics of the sludge, and current sludge disposal methods. Suitable sludge disposal alternatives are identified. Except for the various disposal methods currently being practiced by each waste water treatment plant, wet land spreading appears to be the most universally applicable sludge disposal method. Four alternatives are presented for regional sludge management systems, all involving four centralized processing facilities with sludge dewatering capabilities. The dewatered sludge would be disposed of in a regional landfill site, a reclamation site, suitable agricultural land, or by incineration.

*Waste water treatment, *Analytical techniques, *Treatment facilities, *Planning, *Sludge disposal, Sludge, Waste disposal, Management, Project planning, Cost analysis, Reclamation, Industrial wastes, Sewage treatment, Water pollution

D333

RELATION OF OPERATION AND MAINTENANCE TO TREATMENT PLANT EFFICIENCY,

Gilbert, W. G.

Environmental Protection Agency,
Washington, D. C.,
Municipal Operations Branch.

Journal Water Pollution Control Federation, Vol. 48, No. 7, p 1822-1833, July, 1976.
5 fig, 9 tab, 20 ref.

Information from Environmental Protection Agency annual surveys on the efficiency of federally funded waste water treatment facilities is presented. A major finding of the survey effort is that about one-third of the nation's municipal treatment facilities constructed with federal grant assistance are not operating at their designed efficiency levels. The causes are many and varied and depend on factors related to each specific treatment facility. Areas where increased emphasis is necessary to assist in improving the efficiency and reliability of treatment facility performance include: the strengthening of municipal operations programs at the local, state, and federal levels; the development of expanded capabilities to provide technical operational assistance to municipal facilities; the identification and satisfaction of treatment facility operator needs; the improvement of laboratory capabilities and testing programs to provide better process control information; the provision of an adequate operating budget at the local level; and the development of simplified and effective process control strategies and methodologies.

*Treatment facilities, *Waste water treatment, *Operation and Maintenance, *Efficiencies, *Operations, Federal government, Surveys, Municipal wastes, Programs, Economics, Quality control

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D334

EFFECTS OF LIME ADDITION ON TREATMENT PLANT OPERATION,

Minton, G. R., and Carlson, D. A.

URS Company,
Seattle, Washington,
Studies and Planning.

Journal Water Pollution Control Federation, Vol. 48, No. 7, p 1697-1727, July, 1976.
12 fig, 13 tab, 60 ref.

The effect of using lime as a clarifying chemical on the total operation of a waste water treatment facility is discussed. Lime addition to the raw waste water can be expected to result in a decrease in suspended solids and oxygen demand in the primary effluent. A relatively clear effluent can be produced at insolubilization pH's of 9.5, 10, 10-11, and 11-11.5 in waste waters of high, moderate, and low hardness and alkalinity, respectively. A coagulant aid will be required for low hardness-low alkalinity waste waters and probably also for a waste water with moderate hardness and alkalinity. The settling rate of the floc will increase, benefiting hydraulically overloaded clarifiers. Modification of the primary effluent will also affect the biological process. Lower organic loadings will occur, benefiting an organically overloaded process; however, it is possible that too low an organic loading will result in a deterioration of the final effluent. Both the quantity and quality of solids and sludge will be significantly altered by lime addition. If the system is operated within the pH ranges identified above, solids will increase by a factor of two to three. The quantity of sludge may not increase correspondingly because of an increase in the solids concentration.

*Lime, *Waste water treatment, *Additives, *Influent streams, *Effluent streams, Biological treatment, Chemical properties, Physical properties, Suspended solids, Oxygen demand, Sludge, Solid wastes, Treatment facilities

D335
THE PERFORMANCE-POTENTIAL OF POLYELECTROLYTES AND HIGH VELOCITY
GRADIENTS IN THE TREATMENT OF WASTEWATERS,

Ogedengbe, O.

Ife University,
Nigeria,
Department of Agricultural Engineering.

Effluent and Water Treatment Journal, Vol. 16, No. 6, p 289-292, June, 1976.
2 fig, 2 tab, 5 ref.

The performance of polyelectrolytes in the coagulation of sewage under varying conditions of velocity gradients was investigated to assess the feasibility of using such materials to obtain higher removals of suspended solids and biochemical oxygen demand in primary sedimentation tanks. High velocity gradients were found desirable up to about 500/sec when a domestic waste water was treated with cationic polyelectrolytes. An extended period of rapid mixing was also found desirable up to about 25 minutes. Turbidity removal was improved when bentonite clay or aluminum sulfate was used as a coagulant aid along with the polyelectrolyte. The results indicated that the management of existing domestic waste water treatment plants can be improved by the use of high velocity gradients, an extended period of shear, and the addition of polyelectrolytes with some form of coagulant aid to the primary treatment units. The total length of time required (30 minutes of rapid and slow mixing plus 20 minutes of quiescent settling) is considerably less than the conventional detention time of about 2 hours commonly used in primary sedimentation.

*Sewage treatment, *Polyelectrolytes, *Coagulation, *Sedimentation, *Sedimentation rates, Biochemical oxygen demand, Suspended solids, Turbidity, Waste water treatment, Treatment facilities, Feasibility studies

Primary sedimentation

D336
FOR NITRIFICATION - ONE SLUDGE OR TWO,

Brown, C. G.

P. E. Brown and Devlin Associates, P. C.,
Consulting Engineers,
West Seneca, New York.

American City and County, Vol. 91, No. 7, p 49-50, July, 1976. 1 tab.

A pilot plant study comparing parallel systems of carbon oxidation and nitrification versus combined nitrification revealed no apparent differences in the efficiency and performance of one- and two-sludge nitrifying systems operated under the same growth conditions at the same temperature. The pilot study was conducted at two temperatures: 8 C and 20 C. The maximum growth rates of nitrifying bacteria at these two temperatures were determined to be 0.25 days and 0.5 days, respectively. Essentially complete nitrification was attained at both temperatures at biological solids retention times of 20 days and 10 days, respectively. The results of the study indicated that nitrification in the activated sludge process can be effectively controlled by application of the concept of biological solids retention time and appropriately determined sludge wasting policies. The results also indicated that the nitrification process should be selected on the basis of economic and operating criteria rather than on process performance.

*Nitrification, *Activated sludge, *Pilot plants, *Efficiencies, *Nitrogen fixation, Nitrogen fixing bacteria, Waste water treatment, Performance, Evaluation, Temperature, Design criteria

D337
DENITRIFICATION OF WASTEWATER EFFLUENTS WITH METHANE,

Sollo, F. W., Jr., Mueller, H. F., and Larson, T. E.

Illinois State Water Survey,
Urbana.

Journal Water Pollution Control Federation, Vol. 48, No. 7, p 1840-1842, July, 1976.

The feasibility of using methane as a carbon source for denitrifying waste water effluents was investigated. Columns packed with 0.32 to 1.27-centimeter gravel were used as the reactors in most of the experiments. The liquid level was maintained at approximately one-half of the column height, and methane was added to the upper portion. The medium was recirculated downflow so that the liquid was able to dissolve methane from the atmosphere in the upper section before entering the lower flooded half of the column. Identical systems with methanol as the reducing agent were operated with nitrogen as the gas phase. Tests with parallel operations indicated that the rate of nitrate reduction with methane as the carbon source did not approach that observed with methanol. With methane, the maximum rate obtained was about 0.70 milligrams/hour/liter (as nitrogen); whereas with methanol as the carbon source, a rate of 4.6 milligrams/hour/liter (as nitrogen) was obtained. Efforts to increase the rate of nitrate reduction with methane using expanded columns failed, though such columns did increase the nitrate reduction rate when methanol was used as the carbon source. In view of the low nitrate reduction rate and problems involved in supplying dissolved methane to the denitrifying bacteria, denitrification with methane does not appear to be economical.

*Denitrification, *Methane, *Waste water treatment, *Feasibility studies, *Kinetics, Biological treatment, Performance, Evaluation, Chemical reactions, Waste treatment, Bacteria, Nitrates, Reduction (chemical), Economics

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D338
AUTOMATION IN SEWAGE PROCESSING,

Michel, E.

Siemens AG,
Karlsruhe, West Germany,
Measurement and Process Engineering Division.

Siemens Review, Vol. 43, No. 5, p 184-190, May, 1976. 9 fig, 9 ref.

Automated instrumentation for the monitoring and control of sewage plant operations is discussed, with particular reference to a chemical oxygen demand measuring system and closed-loop control. The chemical oxygen demand measuring system requires an analysis time of about 25 minutes and can operate for 8-10 days without maintenance. Analysis takes place in a double-beam photometer with a reference beam of 750 nanometers and a measuring beam of 440 nanometers. The measuring ranges are: 0-100, 0-500, and 0-1000 milligrams of chemical oxygen demand/liter. A closed-loop control system is illustrated in which the oxygen supply is controlled by a reference variable expressing the amount of oxygen required for decomposition of the organic matter in aeration tanks. A photoelectric program transmitter can be connected to provide a reference variable expressing the daily oxygen load curves as empirical values. Advantages offered by the use of process computers in the control of sewage plant operations are also discussed.

*Treatment facilities, *Automation, *Monitoring, *Automatic control, *Sewage treatment, Chemical oxygen demand, Computers, Analytical techniques, Photometry, Design criteria, Equipment

D339

UTILIZATION OF ALUMIZED RED MUD SOLIDS FOR PHOSPHORUS REMOVAL,

Shannon, E. E., and Verghese, K. I.

Black, Crow and Eidsness, Incorporated,
Consulting Engineers,
Gainesville, Florida,
Process Design Department.

Journal Water Pollution Control Federation, Vol. 48, No. 8, p 1948-1954, August, 1976.
3 fig, 4 tab, 6 ref.

The feasibility of using alumized red mud solids to precipitate phosphorus from water was investigated. Alumized red mud solids are the product obtained when red mud (a waste material formed during the production of alumina) is slurried with sulfuric acid followed by heat drying and crushing of the resulting solid product. Preliminary pilot plant studies revealed that the use of alumized red mud solids as a coagulant in full-scale phosphorus removal facilities is technically feasible. Practical dosage levels required to achieve a 1-milligram/liter total phosphorus level were around 200 milligrams/liter. Full-scale demonstration studies are planned to confirm the pilot plant results. Chemical cost savings on the order of 35% over traditional phosphorus removal systems are anticipated. Raw waste water biochemical oxygen demand and suspended solids removals obtained by the use of the alumized red mud solids at a dose of 200 milligrams/liter were comparable with removals obtained by alum at 200 milligram/liter and superior to those obtained by lime at 250 milligrams/liter.

*Water treatment, *Phosphorus, *Coagulation, *Pilot plants, *Feasibility studies, Costs, Biochemical oxygen demand, Suspended solids, Evaluation, Performance, Byproducts, Chemical precipitation

Alumized red mud

D340

SODIUM ALUMINATE IMPROVES SLUDGE PROPERTIES,

Lenhart, C. F.

Wastewater Treatment,
Greene County, Ohio.

American City and County, Vol. 91, No. 8, p 36-37, August, 1976.

The use of sodium aluminate to improve sludge properties was evaluated during a 43-week study at an activated sludge waste water treatment plant. During the study, liquid sodium aluminate was added at a rate sufficient to produce a concentration of 10 milligrams/liter (as aluminum) in the sewage as it entered the aeration tanks. Three 4-week addition periods were separated by equal periods with no alum addition. The median sludge volume index during the aluminate treatment was 86 as compared with 146 during the non-treatment periods. Aluminate addition also resulted in increased floc density which kept the secondary clarifier sludge blanket in place, preventing washouts even during periods of severe hydraulic overload. The denser floc also proved helpful in sludge digestion. It became easy to form a separable supernatant that was low in biochemical oxygen demand and suspended solids and that could easily be withdrawn from the aerobic digestion tanks. Phosphorus removal during the treatment periods averaged 80% as compared with a normal 42% removal without aluminate. Residual benefits in the process continued for 10 days after aluminate feed was discontinued. Improvement was observed within 24 hours following the initiation of aluminate addition.

*Waste water treatment, *Activated sludge, *Additives, *Physical properties, *Chemical properties, On-site investigations, Sludge digestion, Phosphorus, Biochemical oxygen demand, Suspended solids

Sodium aluminate, Alum

D341
SOFT WATER CAN MEAN HARD DISPOSAL PROBLEMS,

Zinsmeister, H. F., and Ramaswamy, J. N.

Clyde E. Williams and Associates, Incorporated,
Consulting Engineers,
South Bend, Indiana.

American City and County, Vol. 91, No. 8, p 47-48, August, 1976. 2 fig, 2 tab.

Problems associated with the disposal of brine wastes generated by zeolite softening units are discussed. These wastes contain chloride ions (principally from sodium, calcium, and magnesium compounds) proportional to the amount of salt used in the regeneration of the zeolite. Disposal techniques usually focus on keeping these brines out of local streams since high concentrations of the chlorides formed during the regeneration process can be harmful to both aquatic life and livestock. If limiting values for the constitutents of zeolite wastes are known for a given stream, the flow necessary to dilute the wastes may be estimated. Volume reduction of the brine waste by utilizing the regenerative capacity of the brine is a good treatment method. By returning brine normally exhausted during the regeneration cycle to the brine storage tank, the discharge and treatment of the waste can be reduced by about two-thirds. Estimated waste disposal costs are tabulated for the following treatment methods discussed: reverse osmosis, electrodialysis, lagoon (annual discharge), holding tank with steady discharge, and holding tank (20 years).

*Zeolites, *Water softening, *Waste disposal, *Waste treatment, *Brine disposal, Chlorides, Sodium compounds, Calcium compounds, Magnesium compounds, Reverse osmosis, Electrodialysis, Lagoons, Recycling, Water treatment, Costs

Holding tanks

D342
SINGLE-STAGE NITRIFICATION-DENITRIFICATION,

Bishop, D. F., Heidman, J. A., and Stamberg, J. B.

National Environmental Research Center,
Cincinnati, Ohio,
Advanced Waste Treatment Research Laboratory.

Journal Water Pollution Control Federation, Vol. 48, No. 3, p 520-532, March, 1976.
5 fig, 8 tab, 15 ref.

The removal of 75-84% of nitrogen from primary waste water has been achieved recently in a single-stage activated sludge (30,000-50,000 gallons/day) pilot plant without the use of supplemental organic carbon. The removal was achieved in a two-pass biological reactor in which the dissolved oxygen concentration was varied from 0 to 3 milligrams/liter. Air from a blower was applied on a 30-minute cycle, first to one reactor pass and then to the other. Mechanical mixers suspended the mixed liquor solids when the air was not applied to the pass. Nitrification occurred readily when the dissolved oxygen concentration was equal to or greater than 2 milligrams/liter; when the dissolved oxygen level was decreased to near zero, denitrification occurred. The chemical oxygen demand to total Kjeldahl nitrogen ratio in the waste water entering the reactor controlled the amount of nitrogen removal. A nitrogen removal of 84% was achieved in the summer at a ratio of 10:1; and during the winter, 75% of the total nitrogen based on the primary effluent was removed. Bulking problems limited winter operations and required low overflow rates (300 gallons/day/sq ft) to capture the solids in the clarifier.

*Nitrification, *Denitrification, *Activated sludge, *Waste water treatment, *Pilot plants, Biological treatment, Nitrogen, Dissolved oxygen, Design criteria, Efficiencies, Treatment facilities, Performance, Evaluation

Bulking

D343

CARBON ADSORPTION OF AIR AND WATER POLLUTANTS,

Cheremisinoff, P. N.

Pollution Engineering, Vol. 8, No. 7, p 24-32, July, 1976. 5 fig, 1 tab.

The use of carbon adsorption for the removal of organic compounds from water is discussed. Carbon adsorption systems are of two types, regenerative and nonregenerative. For operations in which daily carbon requirements are large or under constant use, granular carbons offer the advantage of established methods of regeneration which greatly reduce costs and are suited to continuous column design service. Powdered carbons offer advantages in applications where the daily carbon requirements may not be large enough to warrant the installation and operation of regeneration equipment. Adsorption studies with carbon indicate that most of the Environmental Protection Agency-proposed dissolved organic toxic chemicals can be removed from water by activated carbon. Adsorption treatment equipment can consist of adsorbers holding granular activated carbon beds or mixed media filters. Granular carbon is primarily used as a post-filtration adsorption system and is generally limited to large municipal plants and industrial water treatment applications. The powdered form is more commonly used in municipal water plants and requires less capital investment.

*Activated carbon, *Adsorption, *Water purification, *Organic compounds, *Waste water treatment, Treatment facilities, Equipment, Filtration, Economics, Design criteria, Municipal wastes, Industrial wastes

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D344

DON'T WASTE WATERWEEDS,

Wolverton, B., and McDonald, R. C.

National Aeronautics and Space Administration,
St. Louis, Missouri,
National Space Technology Laboratories.

New Scientist, Vol. 71, No. 1013, p 318-320, August 12, 1976. 1 fig, 3 tab.

Experiments conducted by the National Aeronautics and Space Administration indicate that water hyacinths (Eichhornia crasspipes) have the ability to absorb organics, heavy metals, nutrients, and other chemical elements from waste water under tropical and subtropical conditions while producing a large quantity of plant material. This water hyacinth biomass, when grown in sewage free of toxic metals, is a potential source of protein fertilizer, methane gas, and other valuable products. Currently, a water hyacinth chemical waste filtration system consisting of a zig-zag canal 330 meters long, 6.4 meters wide, and 0.8 meters deep is treating 95,000 liters/day of chemical and photo lab waste. On the basis of an analysis of raw sewage from small communities in South Mississippi, a half hectare lagoon covered with water hyacinths with a minimum sewage retention time of 2 weeks is estimated to be capable of purifying the daily wastes of 1000 people. An experimental water hyacinth lagoon has already reduced pollutant levels by 75-80%.

*Water hyacinth, *Waste water treatment, *Nutrients, *Heavy metals, *Organic compounds, Sewage treatment, Biological treatment, Waste treatment facilities, Domestic wastes, Chemical wastes, Fertilizers, Byproducts, Methane

D345

ADVANCED TREATMENT AND PLANNED DEVELOPMENT CONTROL COUNTY'S POLLUTION,

Hotz, K.

Water and Sewage Works, Vol. 123, No. 8, p 74-76, August, 1976. 3 fig.

Plans for a regional sewage collection and treatment system which include a biophysical waste water treatment facility using powdered activated carbon and wet air regeneration are described. The facility will be one of the first permanent applications of such a system in the United States. A development plan is also to be established so that population growth will be promoted where facilities already exist, thus avoiding random growth and making waste water treatment the determining factor in future residential and industrial development. The treatment facility will combine the physical adsorption and biological oxidation phases into a single treatment step, and the system will be incorporated within an existing single stage activated sludge system. The biophysical approach will make it possible for the treatment system to withstand shock loads which often limit the effectiveness of ordinary biological treatment methods. The need for costly disposal of excess activated sludge is eliminated because in the process of regenerating carbon by wet oxidation the accumulated biomass is destroyed.

*Sewage treatment, *Sewerage, *Treatment facilities, *Biological treatment, *Physical control, Adsorption, Activated carbon, Oxidation, Activated sludge, Regional development, Projects

Biophysical treatment

D346

WASTE-TREATMENT PLANT POWERED BY ON-SITE ENERGY,

Smay, V. E.

Popular Science, Vol. 209, No. 3, p 97, 164, September, 1976. 1 fig.

A waste treatment plant design for reducing off-site energy requirements is described. Except for a period from mid-December through February, solar energy and methane are expected to produce more than 90% of the heat required for the plant. A 1500-square-foot flat-plate, glass-covered hydronic solar collector will be the primary source of solar heat. This heat will go mainly to the anaerobic sludge digesters which operate most efficiently at 95 F. Excess solar heat will be used for space heating and domestic hot water. Methane which will be obtained from the sludge digesters as a byproduct will serve as a long-term storage medium for the solar energy. The plant will also recover 75% of the heat from the exhaust air in the vent system and all the heat from the electric (methane-fueled) generator. The building structure will be constructed of concrete blocks and bricks with insulation between. The roof is designed to retain snow for insulation value. Snow will also be used as a solar reflector. The project is due for completion by late 1977.

*Treatment facilities, *Waste water treatment, *Solar radiation, *Methane, *Design criteria, Energy conversion, Heat transfer, Construction, Concrete structures, Materials

E001

INTERACTION BETWEEN SURFACTANT AND DYE IV. APPLICATION OF THE ACRIDINE ORANGE METHOD TO THE SURVEY OF POLLUTION OF ALKYLBENZENE SULFONATE IN RIVERS AND THE SURVEY OF WATER POLLUTION IN KINOKAWA,

Yokoyama, T., Tokutsu, S., and Tsuiisawa, H.

Eisei Kagaku, Vol. 21, No. 6, p 365-368, December, 1975. 4 fig, 3 tab.

A previously tested acridine orange method for determining alkylbenzene sulfonate has been applied to a survey of pollution in river water. Although the proposed method gave slightly higher values than the standard method using methylene blue, it was better because of its small coefficient of variation. It was concluded from the results of the survey that the proposed acridine orange method should be routinely available for the survey of alkylbenzene sulfonate pollution in river water.

*Analytical techniques, *Pollutant identification, *Path of pollutants, Alkylbenzene sulfonates, Rivers, Surfactants, Monitoring

Acridine orange

E002

INSTRUMENTATION FOR ANALYZING TOD (INSTRUMENTELLE TSB-ANALYTIK),

Schulze-Rettmer, R.

Zeitschrift fuer Wasser-und Abwasser Forschung, Vol. 9, No. 1, p 11-17, 1976.
7 fig. 24 ref.

Automatic equipment manufactured by seven different firms for total oxygen demand (TOD) analysis is described. Four of these use dichromate-sulfuric acid at temperatures between 130 C and 180 C. Due to the constant flow and constant temperature of reaction, accuracy of automatic equipment is superior to that of the manual method of dichromate oxygen demand by the reflux method. The other three types of analyzers operate at a higher temperature (900 C) using oxygen and a platinum catalyst. Performance of the analysis is simple and rapid. Ammonia and chlorides are oxidized; nitrate, sulfate and phosphate are partially reduced. The high temperature TOD-measurement procedure is most useful for determining the oxygen demand in certain industrial effluents and process steams. The method has not been established for use in the monitoring of sewage treatment plant effluents or river water.

*Oxygen demand, *Equipment, *Analytical techniques, Automation, Laboratory equipment, Pollutant identification, Instrumentation

Total oxygen demand

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E003

REPRESENTATIVE ANALYTICAL WASTE WATER SAMPLES. NOTE I--A NEW SAMPLER (SIGNIFICATIVA DI CAMPIONI ANALITICI DI ACQUE REFLUE. NOTA I — NUOVO DISPOSITIVO DI CAMPIONAMENTO),

Versino, C.

Inquinamento, Vol. 17, No. 12, p 17-30, December, 1975.

New equipment for taking multiple waste water samples works by determining the level of the liquid in the duct, and positioning the frame on the telescopic rod in such a way that, when the system operates, the pumps are completely submerged. Once the aspiration apertures have been adjusted to the various samples, the equipment is placed in the duct. Following the arrangement of the pipe terminals in each collection receptacle, the system begins to record the position and time of the sampling. The advantages of this system include the definition of a maximum size of the suspended particles in the sample, instantaneous and simultaneous sampling at various depths or at various angles with respect to the axis, and the possibility of differentiating and characterizing parts of the area and the depth of the system under examination. The actual characteristics of the samples are not altered during the process; as with communicating receptacles, there is no air in either the aspiration tubes or the pumps.

Monitoring, Sampling, Analtyical techniques, Equipment, Water analysis, Water sampling

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E004

ENERGY SAVING--AN IMPORTANT CONSIDERATION,

Scherb, K., and Bauer, H.

Water and Pollution Control, Vol. 114, No. 2, p 25, February, 1976. 1 fig.

The development of a new oxygen sensor for use in activated sludge plants is reported. Manufactured by Zullig, the sensor works according to the principle of Todt, based on the production of a polarized current between two different precious metals in an electrolyte solution, the value depending on the amount of dissolved oxygen. The water sludge mixture to be tested is continuously brought to two concentric metal rings (electrodes) by the vertical movement of a cup surrounding the electrodes. The influence of temperature on the produced current is eliminated by a thermistor which compensates for the temperature effect at the moment of measurement. Compared to other oxygen measurement systems, this sensor is low in maintainance, due to the continuous cleaning of the electrodes. Only exterior cleaning and testing is necessary after one or two months of operation. The electrodes are continuously cleaned by means of a rotating grinding stone, which must be replaced about every three to four months. The continuous measurement of dissolved oxygen permits the control required to ensure optimum bacterial sewage breakdown, resulting in a savings in energy.

*Oxygen, *Measurement, *Treatment facilities, Equipment, Activated sludge, Biological treatment, Dissolved oxygen analyzers, Energy

Oxygen Sensor

E005
THE NATURE OF ACTIVATED SLUDGE FLOCS,

Steiner, A. E., McLaren, D. A., and Forster, C. F.

University College,
Cardiff, Wales, United Kingdom,
Department of Microbiology.

Water Research, Vol. 10, No. 1, p 25-30, 1976. 6 fig, 3 tab, 26 ref.

Several studies have confirmed that the settling properties of sludge depend upon the chemical and physical nature of the floc surface and that sludge volume index may be related to the surface charge carried by the sludge particles. Several experimental techniques were implemented to explain the phenomenon of bio-flocculation. These included sludge sampling, electrophoretic mobility measurements, thin layer chromatography, enzymic treatments, and general analytic methods. From this work, it appears that the activated sludge matrix is composed of at least two polymeric species both of which contribute to the negative charge carried by the sludge. This charge affects the sludge settling properties. Within the matrix occurs inter-polymer bonding by metal ions. Because further cation absorption may occur by attachment to hydroxyl units in the polymers, this is believed to be the mechanism by which heavy metal ions are removed during effluent treatment.

*Activated sludge, *Flocculation, Waste water treatment, Biological treatment, Sludge, Polymers, Chemical properties, Physical properties, Analytical techniques

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E006
COMPARISON OF WARBURG AND MARAIS METHODS OF DETERMINING OXYGEN UPTAKE RATE CONSTANTS,

Hung, Y. T., and Eckenfeld, W. W., Jr.

North Dakota University,
Fargo,
Department of Civil Engineering.

Water and Pollution Control, Vol. 114, No. 2, p 6-7, 9, 25, February, 1976. 3 fig, 3 tab, 12 ref.

A major parameter required for the dissolved oxygen model is the oxygen uptake rate constant (k) at which waste waters are biodegraded as they enter a river. The Warburg respirometric technique has been used to determine BOD and k values in waste waters. A second method, that proposed by Marais, combines the use of a galvanic cell oxygen analyzer and a reaeration technique to determine these values. Studies were made to apply the Marais technique to the determination of oxygen uptake rate constant values of the Houston, Texas, Ship Channel waters. Results were compared with those obtained by the Warburg method. The constant for these waters was found to vary from 0.027 to 0.14 per day with an average value of 0.092 per day by the Marais method. Correlations between the results of k values and ultimate BOD values obtained by the Warburg method were poor. It was concluded that the Marais method is better applied to the determination of k values in such waters as the Houston Ship Channel than the Warburg method, particularly because these waters had low oxygen uptake rate values.

*Dissolved oxygen, *Biochemical oxygen demand, *Measurement, *Rates, Biodegradation, Rivers, Texas, Pollutant identification

Warburg method, Marais method, Oxygen uptake constant

E007

IMPROVED METHOD FOR THE PHOSPHATE DETERMINATION IN WASTE WATER (VERBESSERTE METHODE ZUR PHOSPHATBESTIMMUNG IM ABWASSER),

Bretscher, U.

Gas- und Wasserfach-Wasser/Abwasser, Vol. 117, No. 1, p 31-32, 1976. 1 fig, 7 ref.

An improved variety of Ohle's method for the determination of phosphate in waste water is described. To prevent the oxidation of stannous chloride present in the reducing solution on exposure to air, a reducing solution was prepared by dissolving stannous chloride in anhydrous glycerin at 40-50 C. The reducing solution thus obtained is stable for six months, while that according to Ohle's method had to be prepared freshly daily. For reasons yet unclear, the method using the improved reducing solution is slightly more sensitive than the original method.

*Phosphate, *Pollutant identification, *Waste water, *Analytical techniques, Nutrients

Ohle's method

E008

THE PHENOL-SULFURIC ACID TEST,

Benefield, L. D., and Randall, C. W.

Mississippi State University,
State College.

Water and Sewage Works, Vol. 123, No. 2, p 55, February, 1976. 1 fig, 9 ref.

Total carbohydrate content is often measured in biological sludges in order to understand the complex biochemical processes that occur within a biological treatment system. The phenol-sulfuric acid test constitutes an effective alternate method of carbohydrate analysis to the standard anthrone test. The phenol-sulfuric acid method is generally less expensive, less complicated and easier to employ, and will frequently give more realistic results. The new method measures sugars, such as heptoses, pentoses, uronic acids, and the sugar components of nucleic acids, while the anthrone reagent is relatively insensitive to all these substances. The phenol method has also been used for the analysis of carbohydrate in freeze-dried activated sludges, with excellent results. The reagents required for the test and the analytical procedure were detailed. It has been demonstrated that if the analytical result desired is total carbohydrate rather than a specific carbohydrate, the method of choice should be the phenol-sulfuric acid test.

*Phenols, *Analytical techniques, *Sludge, *Carbohydrates, Anthrone test, Measurement, Biological treatment

*Sludge analysis, *Phenol-sulfuric acid test

E009

METHODS AND INSTRUMENTS FOR MONITORING SURFACE WATER AND WASTE WATER QUALITY (VERFAHREN UND GERAETE ZUR UEBERWACHUNG DER OBERFLAECHEN- UND ABWASSERQUALITAET),

Draht-Fachzeitschrift, Vol. 26, No. 1, p 17-19, 1976. 3 fig, 1 ref.

Methods and instruments for monitoring certain physical and chemical parameters of surface waters and waste waters are described. The continuous monitoring of suspended solid matter content is possible by a turbidimetric method based upon the light scattering principle, where the proportion of transmitted light is maintained at a constant value, and the scattered light is a measure of turbidity. The oxygen content is measured by means of a water-impermeable but oxygen-permeable plastic membrane, where the oxygen passing through the membrane generates electric current in an electrochemical cell. The electric conductivity is determined by an inductive method with the water circulated through two ring-core transformers in a closed loop. An autonomous, automatic water quality monitoring station incorporating instruments for the measurement of turbidity, dissolved oxygen, pH value, and conductivity is suitable for continuous operation for three months.

*Monitoring, *Instrumentation, *Waste water, *Surface waters, Chemical properties, Physical properties, Measurement, Oxygen, Dissolved oxygen, Turbidity, Analytical techniques

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E010

INSTRUMENTAL METHODS OF MONITORING ORGANIC POLLUTION,

Briggs, R., Schofield, J. W., and Gorton, P. A.

Water Research Centre,
Stevenage Laboratory,
Herts, Great Britain.

Water Pollution Control, Vol. 75, No. 1, p 47-57, 1976. 6 fig, 2 tab, 16 ref.

The need for an on-line method of measuring organic pollution has been investigated. Methods which have been considered involve measurement of the oxygen necessary to oxidize organic wastes by combustion or wet oxidation, determination of the carbon dioxide produced, and measurement of respiration rate. Several new instruments which are commercially available are compared in terms of costs, accuracy, reproducibility, and reliability. Performance data are compared with those of an instrument which measures ultraviolet light absorption which was developed at Stevenage Laboratory, Great Britain. This ultraviolet method is the cheapest and most reliable method presently available, with instrument readings reproducible to within ± 5 percent of full scale. Inter-relationships between readings obtained with the various methods are discussed and it was found that the correlation coefficient obtained from instrument readings versus BOD, COD, and TOC was significantly better than that obtained with any combination of the three measurements.

*Organic compounds, *Water pollution, *Analytical techniques, *Measurement, *Instrumentation, Pollutant identification, Ultraviolet radiation, Biochemical oxygen demand, Chemical oxygen demand

E011

WATER POLLUTION MONITORING USING MATCHED SPATIAL FILTERS,

Almeida, S. P., and Eu, J. K-T.

Virginia Polytechnic Institute,
Blacksburg,
Physics Department.

Applied Optics, Vol. 15, No. 2, p 510-515, February, 1976. 4 fig, 15 ref.

A prototype optical processing system has been developed for identifying biological specimens called diatoms using matched spatial filtering techniques. This semiautomated system would be an important alternative to the tedious counting and classification operation which is presently conducted under a microscope by a highly trained person. Results were obtained from a parallel processor and demonstrated that matched filtering techniques are capable of identifying the diatoms. The degree of discrimination is dependent on the spatial frequency of the filter, its diatom orientation, the diatom's size variation, and whether the filter was averaged. Construction of the filters, including averaged filters to take into account variations in depth of focus and size, was detailed. Some sample inputs and the signals detected were illustrated. Autocorrelation between signals to identify similar diatoms was also described.

*Monitoring, *Water pollution control, *Filters, Optical properties, Diatoms, Algae, Automation, Instrumentation, Equipment, Pollutant identification

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E012

IDENTIFICATION OF NITROGEN AS A GROWTH-LIMITING NUTRIENT IN WASTEWATERS AND COASTAL MARINE WATERS THROUGH CONTINUOUS CULTURE ALGAL ASSAYS,

Goldman, J. C.

Woods Hole Oceanographic Institution,
Woods Hole, Massachusetts.

Water Research, Vol. 10, No. 2, p 97-104, 1976. 7 fig, 2 tab, 54 ref.

Nitrogen can often be a growth limiting nutrient in both waste waters and in coastal waters in which the major contribution of nutrients originates from domestic waste discharges. The results of continuous culture algal assays on waste water-sea water mixtures supporting this view are reported. Analytical expressions are presented that give the limiting nutrient present in a given water. Two series of assays were conducted on waste waters from the coasts of Massachusetts and Rhode Island. In the first series waste waters representing different degrees of treatment were added to sea water in volume ratios of 1:3 and 1:1 waste water:sea water. In the second series, ratios were reduced to 1:12 and 1:6.5. Waste water was collected at the treatment facilities and mixed with sea water in the desired ratios in the laboratory. All indigenous algae were removed and the particular test algae were added. Particulate nitrogen, ash-free dry weight, and particulate phosphorus were measured to determine algal biomass. The results show that nitrogen is the growth-limiting nutrient in the waste waters studied and in the marine waters receiving these wastes. There was a linear relationship between total inorganic nitrogen in the influent and particulate nitrogen representing algal biomass up to a total inorganic nitrogen concentration of 10 mg/liter. The nitrogen-phosphorus ratios in the test algae varied between 10 and 20 and in the sea water they varied between 4 and 12. Phosphorus had little effect on algal growth. The elimination of phosphate free detergents will have little effect on the degree of eutrophication in coastal waters.

E013

CHLORINATION AND IODINATION OF POLIOVIRUS AND F2,

Cramer, W. N., Kawata, K., and Kruse, C. W.

State of Maryland Department of Natural Resources,
Annapolis,
Maryland Environmental Service.

Journal Water Pollution Control Federation, Vol. 48, No. 1, p 61-76, January, 1976.
6 fig, 5 tab, 43 ref.

There is a need for in-plant studies of virus removal during waste water treatment. The best assessment of virus survival patterns may be obtained by seeding the treatment plant to a high titer with one virus, as has been done with poliovirus III. This type of animal virus, however, is expensive and takes an impractically long amount of time to obtain. Thus, the bacterial virus f2 has been suggested as a substitute for the poliovirus because it so closely resembles members of that enterovirus group. To be an acceptible substitute, f2 must not multiply or die away in waste water and must exhibit a susceptibility to halogenation that is reasonably similar to the more resistant members of the enteric virus group. Both f2 and poliovirus III were seeded together in autoclaved waste water and exposed simultaneously to chlorine and iodine. Results indicated that f2 bacterial virus is an acceptable mode for the enteric virus group. It can be grown in large quantities, and assayed with relative ease.

*Waste water treatment, *Bacteria, *Viruses, Pollutant identification, Model studies, Bioassay

Poliovirus III, f2

E014

NITROGEN AND PHOSPHORUS LEVELS IN SOILS BENEATH SEWAGE DISPOSAL PONDS,

Lund, L. J., Page, A. L., and Nelson, C. O.

California University,
Riverside,
Department of Soil Science and Agricultural Engineering.

Journal of Environmental Quality, Vol. 5, No. 1, p 26-30, January/March, 1976.
4 fig, 2 tab, 12 ref.

Soil cores were collected at two treatment plants beneath sewage sludge and effluent ponds and an evaluation was made of the movement of phosphorus and nitrogen in the soil. Both soil profiles were coarse-textured and open. Total nitrogen in the soils was enriched to 4 m and 8 m, the maximum sampling depths. Considerable excesses of ammonium-nitrogen concentrations compared to controls, as deep as 4.0 m, demonstrated movement of substantial quantities of ammonium in the soil below the ponds. Concentrations of nitrate-nitrogen in soil solutions under disposal sites were considerably higher than those from control sites in situations where sampling encountered the water table, demonstrating that nitrate-nitrogen had reached the water table. Phosphorus enrichment was evident as deep as 3 m beneath the ponds. Ponding sewage waste water on porous open soils and subsequent percolation through soil may contaminate underground water supplies with phosphorus, nitrate-nitrogen, and ammonium-nitrogen. Water table depth, downward soil solution flow rates relative to lateral groundwater flow rates, and resultant mixing influence the extent of the effect.

*Analytical techniques, *Soil analysis, *Phosphorus, *Nitrogen, Path of pollutants, Nutrients, Waste water treatment, Groundwater

E015
RECOMMENDATION FOR THE EVALUATION OF THE BIOLOGICAL DEGRADABILITY OF EFFLUENTS OF VARYING ORIGIN (VORSCHLAG ZUR BEURTEILUNG DER BIOLOGISCHEN ABBAUBARKEIT VON ABWAESSERN UNTERSCHIEDLICHER HERKUNFT),

Straten, G., and Witte, H.

Zeitschrift fuer Wasser- und Abwasser-Forschung, Vol. 9, No. 2, p 38-41, 1976.
3 fig, 30 ref.

Biochemical oxygen demand (BOD) measurements are inaccurate, particularly in the evaluation of the biodegradability of industrial effluents. A method of BOD measurement and evaluation is proposed, to help minimize disadvantages in the sharing of costs of building and maintaining waste water treatment facilities. Effluents are mixed with varying amounts of a standardized food-solution, to guarantee a constant minimum food level in the testflask of the BOD test. The standard liquor has a composition similar to that of domestic sewage. It can then be seen whether the waste water composition in question has any toxic effect on the standard solution. It would be possible to compare the results with different types of effluents in an objective and reproducible manner and to determine what would be the most probable BOD values, when industrial effluent is mixed with domestic sewage.

*Biochemical oxygen demand, *Pollutant identification, *Measurement, Waste water treatment, Standards, Water quality, Biodegradation, Industrial wastes

Municipal/industrial wastes

E016
PHOTOGRAPHIC ANALYSIS OF WATER QUALITY CHANGES,

Lo, C. P.

Photogrammetric Engineering and Remote Sensing, Vol. 42, No. 3, p 309-315, March, 1976. 7 fig, 5 ref.

The effect of coastal reclamation and accompanying changes in land use on water quality in Hong Kong's Rambler Channel was studied. Black-and-white aerial photographs from 1956 were compared with true color aerial transparencies from 1975. Artificial pollution became evident, especially in the inlets and bays where land is reclaimed and factories set up. The most seriously polluted sites usually are in confined locations. Immediate measures for clearing up these sites are recommended. True-color aerial photography in the form of transparencies was found to be useful in identifying pollution sources and types of pollutants.

*Photography, *Water analysis, *Water quality, *Aerial photography, Pollutant identification, Water pollution sources

Hong Kong, Color photography

E017

FACTORS AFFECTING THE EXTRACTION AND ANALYSIS OF POLYNUCLEAR AROMATIC HYDROCARBONS IN WATER,

Acheson, M. A., Harrison, R. M., Perry, R., and Wellings, R. A.

Imperial College,
London,
Public Health Engineering.

Water Research, Vol. 10, No. 3, p 207-212, 1976. 3 fig, 5 tab, 18 ref.

Factors such as the initial concentration of polycyclic aromatic hydrocarbons (PAH), the presence of suspended solids, and prolonged storage of samples prior to analysis, which are expected to affect the efficiency of extraction of polynuclear aromatic hydrocarbons from environmental water samples, were systematically investigated. PAH were added to purified water and to purified water with Fullers Earth added, and then extracted by Ultra-Turrax. Some samples of both solutions were mixed for 6 hr instead of the usual several min, and continuous solvent extraction was compared to Ultra-Turrax for samples containing Fullers Earth. Two extract purification procedures were compared, as were thin layer chromatography (TLC) and gas-liquid chromatography (GLC) for analysis. Both TLC and GLC were used to analyze environmental water samples. Extraction efficiences were between 30% and 85%. Although precise prediction of efficiency for a given sample is impossible, probable extraction efficiency can be predicted and makes more accurate measurements of PAH possible. An existing purification procedure had serious drawbacks, which were overcome by use of dimethylsulfoxide. TLC has poor sensitivity for several compounds, but has high accuracy for the compounds determined and avoids extract purification and associated losses. GLC has a more uniform sensitivity, but is unable to separate some isometic compounds, and is more susceptible to interference by background organic materials, and apparently less accurate than TLC. Use of various analytical techniques on river water and road runoff tended to reaffirm the results of the previous laboratory investigations.

*Analytical techniques, *Pollutant identification, Aromatic compounds, Chromatography, Extraction

Polycyclic aromatic hydrocarbons, Thin layer chromatography, Gas-liquid chromatography

E018

DETERMINATION OF AMMONIA AND KJELDAHL NITROGEN BY INDOPHENOL METHOD,

Scheiner, D.

Technion-Israel Institute of Technology,
Haifa, Israel,
Environmental Engineering Laboratories.

Water Research, Vol. 10, No. 1, p 31-36, 1976. 6 fig, 4 tab, 20 ref.

The Berthelot reaction was studied and modified for determining ammonia and Kjeldahl nitrogen in fresh water and waste water. It is based on development of a deep blue color when ammonia reacts with phenol and alkaline hypochlorite. A stable calibration curve was obtained using samples of known concentration. The modified analytical procedure is convenient and reliable. The phenol, the nitroprusside, and the buffer solution to minimize the effect of the pH of the sample are combined into a single reagent suitable for examining domestic waste water with a pH between 3 and 11.5 without correction. A separate measurement is not needed for the hypochlorite reagent. Results are highly reproducible between 0.02 and one mg/liter ammonia nitrogen. Forty-five minutes are required for the color to develop at room temperature, and it remains stable for 48 hr. Hardness above 400 mg/liter and above 5 mg/liter N nitrite ions can cause interference in domestic waste water. The dilution required by the measurements eliminates this interference in waste water samples that are high in ammonia.

*Ammonia, *Nitrogen, *Pollutant identification, *Waste water, Analytical techniques, Measurement

E019

MONITORING DISSOLVED-OXYGEN CONTENT TO ASSURE CLEAN WASTEWATER,

Reeves, J. R.

Power, Vol. 120, No. 4, p 68-69, April, 1976.

Numerous methods have been developed for measuring dissolved oxygen. These methods derive their importance from the fact that the dissolved-oxygen level must be held within a certain range in the activated sludge process. This process uses aerobic bacteria to break down water pollutants. The laboratory procedures for measuring dissolved oxygen include the Winkler method, which involves a chemical test of a water sample. There are also four alternative electrochemical methods: conductimetric, coulometric, potentiometric, and amperometric. In membrane-electrode techniques, a semipermeable membrane separates the electrolyte and the electrodes from the water. It is preferred that aeration basins contain 0.5 to 2.0 ppm oxygen. They should be measured between 2 and 3 ft beneath the surface near the effluent of the pond. To determine the oxygen concentration of a sample from its partial pressure, its temperature must be known, and most dissolved-oxygen analyzers include a temperature-sensing element.

*Dissolved oxygen, *Measurement, *Monitoring, *Activated sludge, Aeration, Waste water treatment, Pollutant identification, Analytical techniques

Dissolved oxygen analyzers

E020

AN IMPROVED DETERMINATION OF CHEMICAL OXYGEN DEMAND IN WATER AND WASTES BY A SIMPLIFIED ACID DICHROMATE DIGESTION,

Canelli, E., Mitchell, D. G., and Pause, R. W.

New York State Department of Health,
Albany,
Division of Laboratories and Research.

Water Research, Vol. 10, No. 4, p 351-355, 1976. 3 fig, 1 tab, 22 ref.

An improved method was developed for determining chemical oxygen demand (COD) in water and waste water samples containing up to 1500 mg chlorine/liter. Sulfuric acid, potassium dichromate, silver sulfate, mercury (II) sulfate, and sulfamic acid are used to digest samples for 2 hr in glass tubes. While being digested, the samples are heated at about 140 C without boiling or refluxing. A colorimetric determination of excess dichromate oxidant is then performed. About 12 samples can be analyzed per hr. It is not necessary to correct for chlorine interference when there is less than 500 mg chlorine/liter. Three mg/liter is the detection limit. At 112 mg COD/liter, the relative standard deviation is 4.3%. This procedure was compared with the standard dichromate reflux method by analyzing 35 samples of waste water. The two data sets did not differ significantly.

*Chemical oxygen demand, *Analytical techniques, *Waste water, *Water analysis, Laboratory tests

Acid dichromate digestion

E021

MODERN TECHNIQUES OF WASTE DETECTION,

Burch, R. H., and Marlow, K. C.

East Worcestershire Waterworks Company,
Bromsgrove, Great Britain.

Water Services, Vol. 81, No. 960, p 179-182, March, 1976. 3 fig.

The East Worcestershire Waterworks Company supplies water to a mixed rural and industrial community of about 300 sq mi. Until recently, sand from the wells from which most of this water is obtained entered the distribution system and eventually contributed to waste problems. Waste is defined as water supplied that cannot be accounted for in terms of legitimate domestic, metered, or bulk consumption. Waste dropped from 30% to 26% between 1963 and 1970, due to various water conservation measures. A new waste detection system was instituted in which a computer is used to compare flows at various points in the system. The system was divided into zones. Unusual demand in a zone is indicated by deviation of the solution of the zonal equation from known limits; sudden demands can be located within minutes. Every 24 hr, minimum night line figures are logged for all zones, to detect gradual waste increases. The equations consider losses or gains in reservoir levels in determining water consumption. Flow data is transmitted digitally, in units of 4546 liters for major source works and 455 liters for smaller flows. This system has reduced waste from 25% to 19% since 1971. The effect of pressure on waste level is also being studied.

*Water treatment, *Distribution systems, Analytical techniques, Data collection, Flow rates, Pressure, Computers

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E022

THE RELATIONSHIP BETWEEN DISSIMILATORY NITRATE REDUCTION AND OXYGEN UPTAKE BY CELLS OF AN ALCALIGENES STRAIN IN FLOCS AND IN SUSPENSION AND BY ACTIVATED SLUDGE FLOCS,

Krul, J. M.

Agricultural University,
Wageningen, The Netherlands,
Laboratory of Microbiology.

Water Research, Vol. 10, No. 4, p 337-341, 1976. 7 fig, 1 tab, 17 ref.

The effect of oxygen concentrations on the oxygen uptake and the dissimilatory nitrate reduction by anaerobically grown cells in flocs and in suspension was studied. A number of isolated bacteria of a denitrifying Alcaligenes strain were tested for ability to form flocs, the floc's sensitivity toward dispersion by cellulase, and denitrifying ability. Nitrate reduction by cells in flocs increased considerably at oxygen concentrations below 1.5 mg/liter. For cells in suspension, nitrate reduction increased at oxygen concentrations below 0.1 mg/liter. Cells grown anaerobically became sensitive to inhibition of respiration by nitric oxide from nitrate reduction after 24 hr of aeration in a medium free of nitrogen. As a result, nitrate reduction increased below 2.5 mg oxygen/liter for cells in flocs and below 0.1 mg oxygen/liter for cells in suspension.

*Oxygen, *Nitrates, *Flocculation, *Bacteria, Anaerobic conditions, Nitrogen, Analytical techniques, Sludge treatment

Oxygen uptake

E023

APPLICATION OF REAL-TIME MASS SPECTROMETRIC TECHNIQUES TO ENVIRONMENTAL ORGANIC GEOCHEMISTRY. I. COMPUTERIZED HIGH RESOLUTION MASS SPECTROMETRY AND GAS CHROMATOGRAPHY-LOW RESOLUTION MASS SPECTROMETRY,

Simoneit, B. R., Smith, D. H., and Eglinton, G.

California University,
Berkeley,
Space Sciences Laboratory.

Archives of Environmental Contamination and Toxicology, Vol. 3, No. 4, p 385-409, 1976. 5 fig, 1 tab, 41 ref.

A mass spectrometer/computer system (LOGOS) was used to study organic compounds in the environment. A water-borne particulate sample, an air particulate sample from Bristol, England; filtered water samples from San Francisco Bay; and a sewage sludge sample were examined. The mass spectrum for the water-borne particulate sample consisted predominantly of hydrocarbon ions of relatively high degrees of unsaturation. The air particulate sample contained a more diverse and complex mixture. Species containing between one and four oxygen atoms made important contributions to the mixture. Solvent soluble extracts of water from the San Francisco Bay consisted predominantly of a variety of complex hydrocarbon mixtures. The relative amounts of the various hydrocarbon structural types varied widely. The major compound investigated in sewage sludge was bis(p-chlorophenyl)acetonitrile(p,p'-DDCN). The LOGOS system normally calculates composition according to numbers of carbon, hydrogen, and chlorine atoms within a specified range; but, to investigate a specific compound, another atom, in this case nitrogen, can be added and the maximum empirical formula specified only slightly larger than the empirical formula of the compound of interest. The mass spectrometer/computer system was very satisfactory for preliminary data characterization.

*Organic compounds, *Pollutant identification, *Spectrometry, *Computers, Sewage treatment, Gas chromatography, Carbon, Hydrogen, Chlorine, Data collection, Analytical techniques

LOGOS

E024

DISSOLVED OXYGEN ANALYZER T-01 ANALYZER. A SIMPLE APPARATUS FOR ELECTROCHEMICAL DETERMINATION OF DISSOLVED OXYGEN IN WATER (Tlenomierz T-01 uproszczony przyrzad elektrochemicznego oznaczania tleunu roxpuszczomego w roztworach wodnych),

Czerniec, J., Gregorowicz, Z., Fligier, J., Zielinski, J., and Lexzozynski, W.

Inzynieria Sanitarna, Vol. 19, No. 443, p 133-141, 1976.

An analyzer has been developed for the electrochemical determination of dissolved oxygen in water. This dissolved oxygen analyzer, model T-01, is a galvanic cell consisting of a silver-lead couple separated from the test sample by a polyethylene membrane. Simple measurements may be made based on the output current without amplification or temperature compensation.

*Analytical techniques, *Dissolved oxygen, *Instrumentation, Water analysis, Pollutant identification, Electrochemistry

E025

ORGANIC CONTAMINANTS OF WATER,

Hamilton, C. E.

Dow Chemical U.S.A.,
Midland, Michigan,
Midland Division Waste Control.

ASTM Standardization News, Vol. 4, No. 1, p 34-35, 49, January, 1976.

Organic matter of either human or natural origin causes problems in drinking water and industrial water. Little is generally known about the specific organic compounds in a water waste stream; many possible products of reactions among the contaminants may never have been isolated or identified. Little effort is made to define the constituents precisely except when adverse effects on humans or the environment are suspected. Sensory perception, by sight or smell, of organic pollution, although subjective, is widely available, inexpensive, and very sensitive to certain types of contamination. Smell has not been widely used due to the variation in individual response to the same stimuli. Photometers and colorimeters can be used to improve upon visual observation. Invisible portions of the spectrum can also be used. Biochemical oxygen demand (BOD) measures the oxygen required to stabilize biodegradable material, but can only be compared among similarly tested samples. Chemical oxygen demand (COD) does not measure organics specifically, because some inorganics also reduce the chemical oxidant. The organic concentration can be determined from the results of a form of total carbon analysis. The total oxygen demand measures the ultimate oxygen required to stabilize the contaminants, but may not accurately indicate organic content because some inorganics consume oxygen and some substances release oxygen. Solvent extraction and activated carbon absorption determine total organic contaminants, but variable extraction efficiencies, loss of volatile organics, and water and organic salts accumulation must be considered. Use of gas chromatography to analyze organic water contaminants has begun and will probably increase.

*Analytical techniques, *Pollutant identification, *Organic compounds, Biochemical oxygen demand, Chemical oxygen demand, Activated carbon, Gas chromatography

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E026

LABORATORY CENTRIFUGE SAVES TIME AND MONEY,

Martinson, S., and Deaner, D. G.

Water and Sewage Works, Vol. 123, No. 1, p 61-63, January, 1976. 3 fig, 1 tab, 6 ref.

Centrifugal and gravimetric analyses of activated sludge and mixed liquor suspended solids were compared for controlling the activated sludge process. Grab samples from the Sacramento County's Central Treatment plant were analyzed by both methods. The fundamental problem with using the centrifuge is that the percent centrifuge concentration is constant only for a given sludge. However, except for modes of operation such as contact stabilization and activated sludge with reaeration, the mixed liquor suspended solids and the return sludge concentration are the same sludge, and the return rate can be calculated. For an example with actual data, return rates of 27% and 26% were calculated by centrifugal and gravimetric means, respectively. However, the gravimetric results took several hours to obtain, while the centrifugal results were available in 15 min. The shorter time required for analysis enables the operator to respond more quickly to changes in the process.

*Analytical techniques, *Centrifugation, *Activated sludge, Suspended solids, Control, Waste water treatment

Gravimetric analysis, Mixed liquor suspended solids

E027

EVALUATION OF COMBINED APPLICATIONS OF ULTRAFILTRATION AND COMPLEXATION CAPACITY TECHNIQUES TO NATURAL WATERS,

Smith, R. G., Jr.

Skidaway Institute of Oceanography,
Savannah, Georgia.

Analytical Chemistry, Vol. 48, No. 1, p 74-76, January, 1976. 1 fig, 2 tab, 11 ref.

The application of a combination of ultrafiltration, membrane fractionation, and anodic stripping voltammetry to studying the distribution of complexing materials in natural waters was evaluated. Each sample was separated into several fractions, and the complexation capacity of each fraction for copper was determined. Between 80 and 90% of the total dissolved organic carbon was recovered after fractionation with a ± 4% coefficient of variation. Precision of ± 8% was obtained. The technique was applied to samples from five stations in a Georgia estuary. The apparent ability of low molecular weight fractions to complex copper increased with increasing salinity. This method should be useful in studying the mechanisms of trace metal interaction with organics in river systems.

*Membrane processes, *Organic carbon, *Rivers, Pollutant identification, Analytical techniques

*Ultrafiltration, *Anodic stripping voltametry

E028

SOLVENT EXTRACTION STUDY FOR SIMULTANEOUS DETERMINATION OF SIX TRACE METALS IN RIVER WATER,

Tweeten, T. N., and Knoeck, J. W.

North Dakota State University,
Fargo,
Department of Chemistry.

Analytical Chemistry, Vol. 48, No. 1, p 64-67, January, 1976. 4 tab, 12 ref.

A solvent extraction method was investigated for simultaneous determination of zinc, copper, iron, lead, cadmium, and manganese in river water at the parts per billion level. The metals were chelated with diethyldithiocarbamate, concentrated into isoamyl alcohol by solvent extraction, and identified by atomic absorption spectrophotometry. A standard reference solution of zinc, copper, iron, lead, cadmium, and manganese was added to river water samples. Only copper was quantitatively recovered. Adjusting the sample pH appeared to have little constructive effect on quantitative recovery. At least 90% solvent extraction efficiency was obtained in distilled deionized water for all metals but manganese, whose recovery was 59.6% efficient. Based on this study, solvent extraction is considered unacceptable for analyzing multiple metals in a natural water system.

*Heavy metals, *Rivers, *Analytical techniques, Chelation, Zinc, Copper, Iron, Lead, Cadmium, Manganese, Pollutant identification

*Solvent extraction

E029

HOW TO DESIGN AERATED LAGOON SYSTEMS TO MEET 1977 EFFLUENT STANDARDS,

White, S. C., and Rich, L. G.

Water and Sewage Works, Vol. 123, No. 4, p 82-83, April, 1976. 1 fig, 1 tab.

As part two of a four-part series on experimental studies conducted in South Carolina on the control of suspended solids in aerated lagoon effluents, this paper shows how the results of the studies are used in the design of aerated lagoon systems with effluent standards. Two classes of aerated lagoons currently in use are the completely-mixed (or completely-suspended) and the facultative (or partially-suspended) types. The completely mixed type is discussed in detail. An equation is provided to demonstrate how the residual substrate found in the effluent from a completely mixed system is based on a steady-state mass balance of an organic substrate. Temperatures of aerated lagoons can be estimated with a relationship derived from a thermal energy balance across a completely-mixed system; the appropriate equation is provided. A graph compares power-level requirements for oxygen and solids suspension in a completely-suspended aerated lagoon fitted with surface aerators to treat a typical domestic waste water. In a partially-suspended (facultative) aerated lagoon, oxygen requirements increase, due to BOD feedback from the deposited solids. Oxygen requirements may be estimated for such lagoons, with the value of the BOD removed varying from winter to summer conditions.

*Suspended solids, *Lagoons, *Aeration, Biochemical oxygen demand, Waste water treatment, Effluents, Design criteria

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E030

PROBLEMS CONCERNING THE CHARACTER OF OXIDIZABILITY OF CERTAIN ORGANIC SUBSTANCES IN WATER TREATED WITH OZONE (PROBLEMES LIES A L'EVOLUTION DU CARACTERE D'OXYDABILITE DE CERTAIN CORPS ORGANIQUES PRESENTS DANS L'EAU TRATEE PAR L'OZONE),

Block, J. C., Morlot, M., and Foliguet, J. M.

Techniques et Sciences Municipales—L'Eau, Vol. 71, No. 1, p 29-34, January, 1976. 8 fig, 1 tab, 14 ref.

While the action of ozone on organic products in water produces impressive changes in such parameters as color and turbidity, it is not necessarily indicative of in depth or complete structural modifications. The evolution of biodegradability and oxygen demand, both of which vary considerably depending on the substances being treated, can impose certain constraints upon treatment such as the possible proliferation of microorganisms in the distribution network or a significant chlorine demand following ozonation. It is difficult to evaluate the efficacy of treatment or the quality of a sample due to the disparity of measures. Thus, in the case of 4 samples tested — an E. coli suspension, a 300 ppm anionic detergent solution, a 123 ppm malathion solution, and a soil extract solution of a yellow-brown color—an identical 20% elimination of organic carbon was expressed by a disappearance of 50% color from the soil extract, of 95% turbidity of the bacterial suspension, of 96% of malathion molecules, and only of 10% of detergent.

*Organic compounds, *Waste water, *Ozone, *Water treatment, Oxidation, Pollutant identification, Color, Turbidity

E031

BIODEGRADABILITY AND PROCESS FOR BIOLOGICAL PURIFICATION OF WASTE WATER (LA BIODEGRADABILITE ET LES PROCEDES D'EPURATION BIOLOGIQUE DES EFFLUENTS),

Laboureur, P.

Techniques et Sciences Municipales L'Eau, No. 2, p 45-51, 1976. 1 fig.

The assessment of biodegradation is discussed. Biological degradation is a process which occurs naturally to prevent accumulation of organic matter; its agents are aerobic microorganisms. General methods of assessment are based on measurement of oxygen (respirometric method) or organic carbon. In any waste water treatment method, it is important to know the biodegradation rate. Because no known organisms are able to thrive on synthetic organics, alternative treatment methods to biological treatment must be employed.

*Biological treatment, *Biodegradation, *Waste water treatment, *Measurement, Oxygen, Organic compounds, Microorganisms, Analytical techniques

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E032

TURBIDIMETER LIGHTS THE WAY TO ACCURATE PROCESS CONTROL,

Process Engineering, p 87-88, February, 1976. 4 fig.

In the late 1960's only a few process photometers were available, most of which depended on effects such as extinction/absorption or scattering. Disadvantages of these meters included the need for large dilutions; the need for frequent cleaning, calibration, and maintenance; and sensitivity to color changes. A four beam alternating light photometer was subsequently developed, with a probe which can be submerged in the material being measured. It was designed to be sufficiently accurate for process control. The probe has two lamps, which can be lit alternately, and two photocells, with the fluid to be measured between the lamps and photocells. The extinction module of the fluid is determined from the current from the two photocells using one lamp at a time. Because the equations used eliminate the photocell currents and photo-electric constants, the measurements are independent of lamp intensity or dirt on the lamps or photocells.

*Analytical techniques, *Turbidity, *Photometry, Pollutant identification, Equipment

*Process control, Turbidimeter, Photocells

E033

DEVELOPMENT OF A MEASUREMENT METHOD FOR THE TOTAL ACTIVITY RATE OF ACTIVATED SLUDGE (CONTRIBUTION A LA MISE AU POINT D'UNE METHODE DE MESURE DU TAUX D'ACTIVITE TOTALE DES BOUES ACTIVEES),

Legeron, J. P., and Aim, R. B.

Universite des Sciences et Techniques du Languedoc,
Montpellier, France,
Laboratory of Chemical Engineering.

Water Research, Vol. 10, No. 4, p 273-278, 1976. 10 fig, 4 tab, 28 ref.

An examination was made of the total dehydrogenase activity of activated sludge, according to an enzymatic reaction. Such parameters as pH, temperature, incubation time, and TTC were discussed. The extraction of triphenylformazan and the blank procedure were discussed, along with factors which influence the test. For the control of activated sludge facilities, a modified procedure for the TTC-test was provided. This takes into account organic substrate oxidation and the activity of the different dehydrogenases.

*Activated sludge, *Measurement, *Enzymes, *Analytical techniques, Organic compounds, Oxidation

Dehydrogenase activity, TTC measurement, Triphenylformazan extraction

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E034

STEROIDS IN EFFLUENTS,

Dawson, J. P., and Best, G. A.

Clyde River Purification Board,
Glasgow, Scotland.

Proceedings of the Analytical Division, Chemical Society, p 311-315, December, 1975. 1 fig, 4 tab, 4 ref.

The use of coprostanol, a steroid, was investigated as an internal tracer for fecal contamination in water. The method was first tested on spiked samples; steroid concentrations were then determined at various stages of treatment in sewage works, upstream and downstream from an effluent discharge, near a large sewage works discharging settled sludge into an estuary, near a small outfall discharging macerated sewage, and at various remote areas on the West coast of Scotland. The reduction of coprostanol due to sewage treatment was similar to that of conventional water pollution parameters. The coprostanol concentration gradually decreased with distance downstream from the effluent discharge, but the cholesterol concentration showed no such trend, probably because cholesterol from farm drainage had entered the stream above the discharge. Tests in the estuary also showed the advantate of coprostanol over cholesterol as a tracer. Coliform counts were more variable than steroid analysis; steroids were rapidly diluted in the estuary, and steroids and coliforms were found in surface water over 20 km from the discharge. It was difficult to compare results from coprostanol, cholesterol, and coliform measurements near the small outfall, due to the variability of results. Results from both fresh and saline water indicated coprostanol to be a good indicator of fecal pollution. Coprostanol analysis requires more time than bacteria counting, but analysis does not need to be done immediately, and the results obtained are less subject to error.

*Tracers, *Coliforms, Pollutant identification, Sewage treatment, Water pollution, Bacteria

E035

TRACE-ELEMENT ANALYSIS USING X-RAY EMISSION SPECTROSCOPY,

Rendic, D., Blagus, S., Pecar, V., and Valkovic, V.

Institute 'Rudjer Boskovic',
Zagreb, Yugoslavia.

Fizika, Vol. 7, p 112-115, 1975. 2 fig, 3 ref.

The basic process in X-ray spectroscopy consists of exciting a sample with incoming photons or charged particles and detecting the X-rays emitted. It is used to analyze trace elements. Its many fields of application include the study of water pollution. Its advantages include simultaneous determination of all medium-heavy and heavy metals, simple sample preparation and the ability to use small sample quantities, high accuracy, and the ability to detect concentrations as small as one in 1,000,000. An X-ray spectroscopy system has been developed which includes a computer program for automatic analysis of X-ray spectra and determining absolute elemental concentrations. This system is widely used in studying environmental samples. A similar system is being built at the Rudjer Boskovic Institute based on experience with the first system. The development of similar computer programs for analyzing X-ray spectra is included. According to preliminary results, the method has numerous capabilities and advantages for analyzing elements in low concentrations. Using an X-ray source of around 1000 watts would establish X-ray emission spectroscopy as a powerful new technique with applications in fundamental research as well as environmental pollution.

*X-ray spectroscopy; *Analytical techniques, *Pollutant identification, Trace elements, Water pollution, Environmental effects, Metals

E036

DISTRIBUTION OF BDELLOVIBRIO BACTERIOVORUS IN SEWAGE WORKS, RIVER WATER, AND SEDIMENTS,

Fry, J. C., and Staples, D. G.

University of Wales Institute of Science and Technology,
Cardiff, Wales,
Department of Applied Biology.

Applied and Environmental Microbiology, Vol. 30, No. 4, p 469-474, April, 1976.
4 fig, 3 tab, 20 ref.

The source and extent of Bdellovibrio, a bacterial predator, in British rivers were studied, along with the possibility that it could grow or control bacterial populations in river sediments or sewage. Bacteria from samples of river water, liquid sewage, final settlement sludge, and river sediment were cultured, and plaques were counted and examined microscopically. Bdellovibrio occurred in all liquid sewage examined. It also occurred in all river sediments and polluted river waters examined, although it was not found in some of the unpolluted river waters. The predator could multiply on the large numbers of bacteria in aerobic percolating filter films, but not in anaerobic sludge. It occurred in river sediments' aerobic surface layers, but not in anaerobic bottom layers. Sewage works effluents were the major Bdellovibrio source in polluted rivers examined, and numbers in sediment and river water were correlated with the quality of the river water. Bdellovibrio was probably not important in controlling other bacteria either in sewage or in river sediment.

*Pollutant identification, *Bacteria, *Rivers, *Sewage, Aerobic conditions, Anaerobic conditions, Sewage treatment effluents

*Bdellovibrio

E037

POLLUTION INFLUENCE ON THE INFUSORIAL FAUNA (PROTOZOA, CILIATA) OF BULGARIAN RIVERS II. THE OGOSTA RIVER AND ITS EFFLUENTS,

Detcheva, R.

Khidrobiologiia, No. 2, p 19-31, June, 1975. 1 fig, 3 tab, 4 ref.

Species of ciliates were investigated in 56 samples from 14 locations along the Ogosta River, Bulgaria, and its tributaries from spring to autumn 1969. The seasonal influence and the influence of river pollution on the species of ciliates present was studied. Fifteen hydrochemical indices giving some indications as to the saprobiological conditions in the river, compared with previous values. The data exactly coincided for several species. Some deviations occurred in the values of dissolved oxygen, ammonia, and biochemical oxygen demand (BOD).

*Pollutant identification, *Microorganisms, *Rivers, Water pollution effects, Biochemical oxygen demand, Ammonia, Dissolved oxygen

Ciliates, Bulgaria

E038

LABORATORY EVALUATION OF THE COULTER ON-LINE PARTICLE MONITOR,

Barnett, M. I., Sims, E., and Lines, R. W.

Wales University Institute of Science and Technology,
Cardiff, Great Britain,
Welsh School of Pharmacy.

Powder Technology, Vol. 14, No. 1, p 125-130, May-June, 1976. 2 fig, 3 tab, 7 ref.

The Coulter On-Line Particle monitor, which counts particles within specified size intervals for control purposes or continuous monitoring, was evaluated in the laboratory. The monitoring applications studied include filtered electrolyte, intravenous fluids, sea and river water, and microbial growth. Instrumental noise and external interference caused a minor problem, giving a lower limit of about 3% of aperture diameter instead of the normal 2%. When used with the proper Coulter Counter, it has direct application to studying microbiological growth and flocculation. The monitor also has obvious applications to the study of particulate contamination. Sea water and river water were successfully monitored using 100 micron aperture tubes, although the low conductivity of the river water gave rise to some noise generation below 4 to 5% of the aperture diameter.

*Measurement, *Laboratory tests, *Monitoring, Microorganisms, Flocculation, Oceans, Control, Pollutant identification

Coulter on-line particle monitor

E039
REPRESENTATIVE DIRTY WATER SAMPLING,

Jenkins, R.

Effluent and Water Treatment Journal, Vol. 16, No. 3, p 144-145, March, 1976.
2 fig, 3 ref.

Effluent sampling is required to determine the composition of liquids with suspended solids, but the sampling method itself may change the fall-out rate in its vicinity, leading to errors. Many samples are needed due to the varying composition of the fluid, and sampling rate should be proportional to flow, because many processes have periods of high flow rate and low contamination, and low flow rate and high contamination. The simplest continuous automatic sampler is the air displacement sampler, which is immersed in the fluid so that hydrostatic pressure pushes the sample into the sampling chamber. If the inlet is placed at 20% of 'full bore', the rate of sampling against flow rate approximates the characteristic of the pipe or channel. The average absolute error between 10 and 100% of full flow is under 1% for pipes and 2% for channels. The design of this type of sampler ensures that samples are 'representative' due to the design inlet and absence of a pump, and mathematically representative due to the rate of sampling being nearly proportional to flow rate.

*Sampling, *Suspended solids, *Effluents, *Pollutant identification, Municipal wastes, Industrial wastes

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E040
HOW TO BUILD A BETTER BENCH SHEET,

Clark, D. W.

Water Quality Laboratory,
Las Cruces, New Mexico.

Water and Sewage Works, Vol. 123, No. 4, p 69-71, April, 1976. 2 fig.

Laboratory data is valuable in waste water treatment, and a bench sheet has been developed that provides maximum assurance that each test has been properly performed while containing sufficient information that results can be rechecked. Although the bench sheet is the most important repository of laboratory information, the value of a good bench sheet is often overlooked. Bench sheets should be kept separate from interpretations of results and should be of an appropriate size for handling and filing. A bench sheet should provide spaces for complete sample identification and logical development of test data. It should also include auxiliary information and formulas and space for calculations. There should be space for comments and, where more than one person works in the laboratory, a method of accountability. Bench sheets can be designed to show either one determination for all samples or all tests performed on a single sample. A sample bench sheet provides for recording date and time, location, nature of the sample, the person collecting it, dissolved oxygen, temperature, pH, and solids determinations. Most of the data is entered in the order in which it is accumulated. Space for data on percent volatile material is included with the solids data, and for biochemical oxygen demand (BOD) on the reverse side of the bench sheet. The sample volumes most often needed to determine compliance with standards are printed on the sheet, and places are provided to indicate the individuals performing the tests. When completed, the bench sheet records the condition of the effluent on a given day.

*Laboratory tests, *Data processing, Waste water treatment, Analytical techniques, Pollutant identification, Water analysis

E041
EVALUATION OF METHODS FOR PRESERVING THE LEVELS OF SOLUBLE INORGANIC PHOSPHORUS AND NITROGEN IN UNFILTERED WATER SAMPLES,

Klingaman, E. D., and Nelson, D. W.

Purdue University,
Lafayette, Indiana,
Agricultural Experiment Station.

Journal of Environmental Quality, Vol. 5, No. 1, p 42-46, January-March, 1976.
3 tab, 11 ref.

Several methods to preserve levels of ammonium, soluble inorganic phosphorus (SIP), and nitrate in tile drainage water, surface runoff, and river water were evaluated. Samples were stored in the dark at -20, 4, and 23 C, in some cases with mercurous chloride or phenylmercuric acetate (PMA) added, and sampled before storage and after 3, 7, 21, 42, and 84 days. The best overall technique appeared to be frozen storage. Storage at 4 C after mercurous chloride addition also preserved SIP concentration. However, it did not stabilize ammonium and nitrate concentrations either in runoff samples for longer than 6 weeks or in tile drainage water. Treatment with PMA increased the inorganic phosphorus concentration in some samples during storage. The inorganic phosphorus content also changed when samples were stored at 4 C or 23 C without additives.

*Ammonium, *Nitrate, *Phosphorus, Drainage, Runoff, Rivers, Waste treatment, Analytical techniques, Inorganic compounds

Sample storage

E042
SELECTIVE RENOVATION OF EUTROPHIC WASTES PHOSPHATE REMOVAL,

Boari, G., Liberti, L., and Passino, R.

IRSA-CNR,
Bari, Italy.

Water Research, Vol. 10, No. 5, p 421-428, 1976. 5 fig, 5 tab, 20 ref.

As part of the development of a selective process to remove eutrophic species from sewage effluents, the chloride/phosphate equilibrium was studied for various ion resins and the selectivity dependence on several external or internal parameters was evaluated. After being converted into chloride or phosphate form, the resins were tested in columns or by allowing equilibrium to be reached in a flask. Hydrostatic interactions appear to have a great importance in determining resin selectivities in the chloride/phosphate system, but not in the chloride/sulfate equilibrium. The experimental results for the chloride/phosphate equilibrium would lead to selection of a secondary and tertiary amino, porous, 8 to 10% crosslinked, poly-acrylic resin having diethylentriamine (DETA) basic groups for selective removal of phosphate from secondary effluents, with .001 to .006 M total concentration, low phosphate concentration, and 6.5 to 7.5 pH. Equilibrium phosphate uptakes were as high as 0.7 kg phosphate/kg dry resin. Resins having more hydrophilic matrices would require adequate physico-chemical stabilization. A possible alternative is once-through utilization of less chemically resistant resins, re-using the resins directly in phosphate form in soil conditioners or fertilizer.

*Sewage effluents, *Eutrophication, *Nutrient removal, *Phosphates, *Waste treatment, Equilibrium, Chlorides, Recycling

*Phosphate removal, Chloride/phosphate equilibrium

E043

EFFECT OF SURFACTANTS ON THE SPECTROPHOTOMETRIC DETERMINATION OF PHOSPHATE BY DIRECT AND EXTRACTION PROCEDURES,

Pakalns, P., and Steman, H. T.

Australian Atomic Energy Commission,
Lucas Heights, Australia,
Research Establishment.

Water Research, Vol. 10, No. 5, p 437-441, 1976. 1 fig, 4 tab, 4 ref.

The effects of surfactants on determination of phosphate in water and waste water were studied. The surfactants investigated included pure cationic, anionic, and nonionic detergents; industrially prepared detergents; and a soap. Ascorbic acid and stannous chloride spectrophotometric methods and isobutyl acetate extraction were used for determining phosphate. For the spectrophotometric methods, the interference was very large for the cationic detergent but negligible for the biodegradable anionic detergents. The ascorbic acid method, which is simple and elegant, is recommended for routine determination of phosphate in most waters and waste waters containing surfactants. The results show that the standard addition procedure for the extraction method can be used only when the approximate surfactant concentration is known. Cationic and nonionic detergent levels must not exceed 2 and 10 ppm, respectively, but biodegradable anionic detergents do not interfere to at least 1000 ppm. However, compounds present in formulated detergents interfere badly. The extraction method should only be used with samples of at least 50 ml containing no more than 8 ppm of pure detergent.

*Surfactants, *Pollutant identification, *Phosphate, *Spectrophotometry, *Detergents, Cations, Anions

*Extraction method

E044

AN INSTRUMENT WITH INTERNAL CALIBRATION FOR MONITORING CHLORINE RESIDUALS IN NATURAL WATERS,

Marinenko, G., Huggett, R. J., and Friend, D. G.

National Bureau of Standards,
Washington, D. C.

Journal of the Fisheries Research Board of Canada, Vol. 33, No. 4, p 822-826, April, 1976. 2 fig, 3 tab, 5 ref.

A more sensitive field monitor was developed for low level chlorine concentrations. Iodine, resulting from oxidation of potassium iodide by chlorine residual, is measured amperometrically using a platinum microelectrode and a saturated calomel electrode. In the calibrator cell, which operates only when the system is being calibrated, a known amount of iodine is generated by coulometrically oxidizing iodide to iodine, the result being exactly the same as the reaction of chlorine with iodide in aqueous media. The water sample flows at a constant, known rate through the monitor, so that the ratio of electrically generated iodine flux to the water flux corresponds to the iodine concentration. Laboratory tests on the monitor included measurements of repeated quantitative dilutions of tap water and a solution prepared from commercial bleach. Field tests were performed during non-emergency conditions in streams in northern Maryland and during a fish kill in the James River. Data obtained indicated that the new instrument can measure chlorine concentrations down to a few parts per billion. It is portable and has direct read-out display in either microamperes or ppm of residual chlorine.

*Monitoring, *Chlorine, *Iodine, *Laboratory tests, *On-site investigations, Pollutant identification, Rivers, Instrumentation

Chlorine residuals

E045
POTENTIOMETRIC DETERMINATION OF LOW LEVELS OF SIMPLE AND
TOTAL CYANIDES,

Sekerka, I., and Lechner, J. F.

Canada Centre for Inland Waters,
Burlington, Canada.

Water Research, Vol. 10, No. 5, p 479-483, 1976. 2 fig, 5 tab, 18 ref.

A method was developed to determine simple and total cyanide concentrations by manual or automated direct potentiometry using a cyanide ion-selective electrode and the addition-known dilution technique. Samples for either simple or total cyanide determination must be treated chemically before measurement, and samples for total cyanide determination must also be irradiated with ultraviolet light. The method was used to determine cyanide ion down to 2 ppb. A procedure was developed to eliminate the interference caused by ions forming little-soluble salts of silver. Since cyanide in acid solution exists as dissolved hydrogen cyanide gas, which is not sensed by the electrode, only the apparent cyanide due to the interfering salts is determined by measuring at pH 2 to 3. This value is subtracted from cyanide measurements at pH 11.5 to determine the real cyanide concentration. The method is simple and efficient, and results obtained using it compare well with those obtained by a conventional method.

*Heavy metals, *Pollutant identification, *Electrodes, *Potentiometers,
Irradiation, Measurement

*Cyanides

E046
POLLUTION MONITORING DOESN'T HAVE TO BE COSTLY,

Hebert, V.

Hewlett-Packard Company,
Loveland, Colorado.

Instruments and Control Systems, Vol. 49, No. 4, p 27-30, April, 1976. 6 fig.

Automatic data acquisition systems (DAS) controlled by programmable calculators can effectively monitor pollution control systems. Electrical signals from transducers can be processed in the calculator. Pollution control monitoring includes legally required monitoring, monitoring which is necessary for engineering reasons, and informative monitoring which is helpful in running the system. A calculator based data acquisition system is used for pollution control monitoring at an electronic equipment plant. Automated systems are used to treat the diluted waste in rinse waters, but concentrated process wastes are treated under the direct control of a trained operator. The DAS gathers two kinds of information: the time and date of the data and the data itself. The signals from the transducers are analog signals, but a voltmeter converts them to digital information which the calculator can understand. The DAS can generate written data reports. The calculator based DAS has other potential applications, is versatile and easy to program, and is economically competitive with other systems that perform fewer functions.

*Monitoring, *Water pollution control, *Pollutant identification, Automation,
Data collection, Waste treatment

Data acquisition systems (DAS)

E047

ASSESSMENT OF THE MAXIMUM CONCENTRATION OF HEAVY METALS IN CRUDE SEWAGE WHICH WILL NOT INHIBIT THE ANAEROBIC DIGESTION OF SLUDGE,

Mosey, F. E.

Water Pollution Control, Vol. 75, No. 1, p 10-20, 1976. 2 fig, 7 tab, 24 ref.

A method was developed to predict the effect of mixtures of heavy metals on the anaerobic digestion process. Two equations of similar form were obtained, one indicating conditions under which inhibition is expected, and the other indicating conditions under which the probability that digestion will not be inhibited is at least 90%. Both equations include the content of zinc, nickel, lead, cadmium, copper, and solids arriving or in the digesting sludge. Digestion is also safeguarded from heavy metal inhibition when the total weight of these heavy metals in grams arriving daily in the crude sewage does not exceed 4939 times the average daily dry weight in tons of solids fed to the digester. Inhibition of other stages of treatment occurs at heavy metal concentrations similar to those that inhibit anaerobic digestion. The effects on the receiving stream and land on which the sludge is spread must also be considered when formulating suitable conditions.

*Heavy metals, *Anaerobic digestion, *Equations, Solids removal, Sludge disposal

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E048

RETENTION OF METALS IN SEWAGE SLUDGE II: INCORPORATED RADIOISOTOPES,

Lagerwerff, J. V., Biersdorf, G. T., and Brower, D. L.

Agricultural Research Service,
Beltsville, Maryland,
Agricultural Environmental Quality Institute.

Journal of Environmental Quality, Vol. 5, No. 1, p 23-25, January-March, 1976. 5 tab, 20 ref.

Digested sewage sludge samples from Washington, D. C., and Baltimore, Maryland, were columned and leached for up to 240 hr with 0.06 N calcium chloride, as well as with water, to study the release of trace amounts of strontium 85 and cesium 137 introduced earlier. Other sludge samples were subjected to hydrogen peroxide treatment and steambath drying, then to incubating with strontium 85 and cesium 137, and either exhaustive water leaching or equilibration with 0.01 N hydrochloric acid or water for one hr. In terms of the original radioactivity, pretreatment increased release of cesium 137 by water leaching between 9 and 18%, and between 7 and 10% for Baltimore and Washington sludge, respectively, depending on whether pretreatment was with water or 3% hydrogen peroxide. For strontium 85, the corresponding ranges were 47 and 55%, and 41 and 48%. Incubation of sludge at room temperature for 44 mo increased water extractability of both cesium 137 and strontium 85 slightly when the material incubated was kept dry. This effect may have resulted from smaller complexing organic compound concentrations, or compounds with less complexing ability. The isotopes extractability with hydrochloric acid sharply increased when sludge was moist. This effect would also indicate more organic complexes when storage conditions were moist, since a pH decrease affects their stability.

*Metals, *Sewage sludge, *Radioisotopes, Analytical techniques, Sludge analysis, Sampling, Pollutant identification

E049

INTERPRETATION OF INTERNAL TRACER EXPERIMENTS AND LOCAL SOJOURN TIME DISTRIBUTIONS,

Zvirin, Y., and Shinnar, R.

City College of the New York City University,
New York,
Department of Chemical Engineering.

International Journal of Multiphase Flow, Vol. 2, No. 5/6, p 495-520, April, 1976. 11 fig, 2 tab, 29 ref.

A general approach for the interpretation of tracer experiments designed to study transport processes in flow systems with multiple inlets and outlets is described. A method for the description of these processes is suggested based on the definition of such local model-free parameters as the purging rate, mixing rate, equivalent Peclet number, and local sojourn time distributions. These parameters can be determined directly from tracer measurements without resorting to any model. Their values and especially their spatial distributions in the system describe the nature of the mixing and purging (or flushing) processes in the system. Experiments are described in which tracer material is introduced at given points within the system followed by measurements of the resulting concentration histories at the same points as well as at different sites. The results are pertinent to a variety of areas in which tracer experiments are used, including water physiology, hydrology, and the study of dispersion processes in the oceans.

*Tracers, *Flow system, *Flow characteristics, Analytical techniques, Tracking techniques, Measurement, Water pollution, Hydrology, Hydrologic properties, Dispersion, Flow, Mixing

Transport processes, Peclet number

E050

APPLICATION OF A COMPUTER-BASED CHROMATOGRAPH FOR AUTOMATED WATER POLLUTION ANALYSES,

Dowty, B., Green, L., and Laseter, J. L.

New Orleans-Lakefront University,
Louisiana,
Department of Biological Sciences.

Journal of Chromatographic Science, Vol. 14, No. 4, p 187-190, April, 1976. 5 fig, 15 ref.

An automated, computer-based gas chromatographic technique for the analysis of low molecular weight volatile organics extracted from drinking water by a modified head-space technique is described. The volatile organics are thermally desorbed from the water sample and displaced into the head-space by purging the sample with ultrapure helium. These displaced organics are then adsorbed on a polymer (Tenax-GC) material which is packed in a glass liner which in turn fits into a modified injection port of the chromatograph. A Hewlett-Packard reporting gas chromatograph is modified to allow automated collection of volatile organics and their subsequent resolution by capillary chromatographic methods. On-line data collection and reduction are achieved by a digital processor incorporated into the chromatograph. Commands establishing operating parameters and methods of data treatment are given via a keyboard. Automation of the procedure results in improved data reproducibility, with consecutive chromatographic analyses of the same sample showing retention time variabilities in the 0.01-0.1 sec range. The automated procedure can also be used to monitor industrial plant effluents and waste water treatment processes.

*Pollutant identification, *Gas chromatography, *Automation, *Organic compounds, Analytical techniques, Measurement, Water analysis, Equipment, Monitoring, Separation techniques, Computer programs, Polymers

E051

BIOCHEMICAL AND PHYSICAL PROPERTIES OF AN ACTIVATED SLUDGE ON SETTLING CHARACTERISTICS,

Magara, Y., Nambu, S., and Utosawa, K.

Institute of Public Health,
Tokyo, Japan,
Department of Sanitary Engineering.

Water Research, Vol. 10, No. 1, p 71-77, 1976. 12 fig, 1 tab, 18 ref.

Relationships between the settling characteristics of activated sludge floc and its biochemical and physical properties were investigated in a laboratory aeration tank. The sludge volume index increased and the settling velocity decreased with an increase in the organic load. Floc density proved to be the most significant physical property affecting floc settling characteristics. Improved floc settling characteristics were associated with increases in floc density and floc strength and with a decrease in floc size. Settling characteristics were also improved by decreasing the electrophoretic mobility due to the disappearance of extracellular polymers and poly-b-hydroxybutyrate during the process of metabolism. The extracellular polymer parameter was the most significant factor affecting activated sludge floc settling characteristics.

*Activated sludge, *Flocculation, *Settling velocity, *Sewage treatment, *Waste treatment, Physical properties, Biological treatment, Biological properties, Suspension, Sanitary engineering, Chemical properties, Polymers

Sludge volume index, Poly-b-hydroxybutyrate

E052

THE ROLE OF HYDROXYL RADICAL REACTIONS IN OZONATION PROCESSES IN AQUEOUS SOLUTIONS,

Hoigne, J., and Bader, H.

Swiss Federal Institute of Technology,
Zurich, Switzerland.

Water Research, Vol. 10, No. 5, p 377-386, 1976. 4 fig, 10 tab, 45 ref.

A reaction scheme involving hydroxyl radical reactions in ozonation processes in water and waste water was investigated. The hypothesis tested was that the ozone may either react directly with substrates or above a critical pH value may decompose prior to reaction with substrates. Beyond this critical pH value, decomposition products of ozone such as hydroxyl radicals (OH) become the important oxidants. The critical pH-value above which the second type of reaction predominates depends upon both the rate with which ozone reacts directly with the substrates and on the solutes, including reaction products, that enhance or retard ozone decomposition. Results obtained on aquaous model solutions showed that reaction conditions for ozonation can be selected to favor either of the two postulated oxidation mechanisms. While the distinction between the two different mechanisms initiated by ozonation and the use of the data available on each will provide a basis for optimizing the ozonation process, the reaction sequences for real waste water systems are more complex and must be analyzed for the individual cases.

*Ozone, *Waste water treatment, *Kinetics, Biodegradation, Hydrogen ion concentration, Analytical techniques, Equations, Water treatment

*Hydroxyl radicals

E053

BIODEGRADABILITY -- AN IMPORTANT CRITERION FOR THE ENVIRONMENTAL COMPATIBILITY OF SURFACTANTS AND OTHER PRODUCT COMPOUNDS,

Fischer, W. K.

Henkel and Cie GmbH,
Dusseldorf, Germany.

La Rivista Italiana Delle Sostanze Grasse, Vol. 52, No. 11, p 373-376, November, 1975. 3 fig, 6 tab, 1 ref.

Biodegradability is increasingly required by national laws and international directives. The biodegradability testing of anionic surfactants stimulates either the self-purification of surface waters or biological sewage treatments in activated sludge plants in static and continuous flow systems. Biodegradability is being demanded increasingly for all organic product components. These demands pose new problems in testing methodology, international comparability, practical relevance of the results, and definition of official minimum requirements. A test combination has been developed consisting of successive application of a screening test and a model sewage treatment plant test; it permits the biodegradability evaluation of organic compounds by means of generally applicable summary parameters. The biodegradation of all organic materials can be determined via the biochemical oxygen demand (BOD) with the Closed Bottle Test. Similar determinations can be made via chemical oxygen demand (COD), total organic carbon (TOC), dissolved organic carbon (DOC) and carbon dioxide with the modified Closed Bottle Test using pure oxygen saturation. The low concentrations used in the conventional Closed Bottle Test make it useful only for BOD. If these screening tests yield low or questionable degradation rates, a modified confirmatory test especially suited to summary parameters is used to establish the elimination rates attainable under sewage treatment conditions. In the continuous activated sludge test, biodegradability may be observed by comparing values of COD, TOC, or both in coupled activated sludge units.

*Pollutant identification, *Analytical techniques, *Biochemical oxygen demand, *Chemical oxygen demand, *Carbon dioxide, Organic matter, Organic compounds, Carbon, Activated sludge, Biodegradation

Total organic carbon, Dissolved organic carbon

E054

DETERMINATION OF THE CHEMICAL OXYGEN DEMAND (COD) BY POTASSIUM DICHROMATE AT VERY HIGH CHLORIDE CONCENTRATIONS (BESTIMMUNG DES CHEMISCHEN SAUERSTOFFBEDARFS (CSB) GEGEN KALIUMDICHROMAT BEI SEHR HOHEN CHLORIDKONZENTRATIONEN),

Zietz, U.

Gas-und Wasserfach-Wasser/Abwasser, Vol. 117, No. 4, p 181-184, 1976. 1 tab, 10 ref.

A modification of the potassium dichromate method for the determination of the chemical oxygen demand (COD) at very high chloride concentrations without the use of mercury compounds is described. The determination requires closed vacuum flasks for the analysis. Chlorides are quantitatively precipitated in the form of silver chloride. The small chloride concentration resulting from the solubility product of silver chloride is oxidized by the potassium dichromate. The chlorine concentration in the gaseous phase over the solution is negligible. The method is suitable for the determination of even very low COD values.

*Chemical oxygen demand, *Potassium compounds, *Analytical techniques, *Chlorides, *Chemical precipitation, Solubility, Oxidation, Aqueous solutions, Pollutant identification

Potassium dichromate

E055

ANALYTICAL NOTES—ELECTROCHEMICAL METHOD FOR EARLY DETECTION AND MONITORING OF COLIFORMS,

Wilkins, J. R., and Boykin, E. H.

National Aeronautics and Space Administration,
Hampton, Virginia,
Langely Research Center.

American Water Works Association Journal, Vol. 68, No. 5, p 257-263, May, 1976.
4 fig, 4 tab, 11 ref.

An electrochemical method for the detection and monitoring of coliforms in naturally contaminated estuarine and fresh water samples was evaluated. The method was based on the observation that the inoculum size was directly related to the time period required for the detection of hydrogen which is evolved by coliforms as a result of lactose metabolism. Standard methods of coliform analysis were performed on fresh water and estuarine samples, and membrane filtration counts were used to construct dose-response curves. Samples containing coliforms in the range of 100-1000/100 ml were detected in 6.2-8.5 hr for total coliforms in estuarine or fresh water samples, 3.5-6.5 hr for fecal coliforms in estuarine water, and 5.0-7.0 hr for fecal coliforms in fresh water samples.

*Analytical techniques, *Pollutant identification, *Electrochemistry, *Hydrogen, *Coliforms, Estuaries, Freshwater, Evaluation, Metabolism, Measurement, Aquatic microorganisms

Electrochemical methods, Fecal coliforms

E056

ANIONIC AND NON-IONIC SURFACTANT BIODEGRADATION IN A PURIFYING PLANT USING ACTIVATING MUDS (BIODEGRADAZIONE DE TENSIOATTIVI ANIONICI E NON-IONICI IN UN IMPIANTO DI TRATTAMENTO A FANGHI ATTIVATI),

Ruffo, C., and Arpino, A.

Stazione Sperimentale Oli e Grassi,
Milano, Italy.

La Rivista Italiana delle Sostanze Grasse, Vol. 52, No. 11, p 383-386, November, 1975.
9 tab, 8 ref.

Since surfactant-containing sewage must be adequately purified before final dumping, sewage sampled both downstream and upstream of a purification plant using activated sludge was analyzed. The treatment removed more than 80% of both non-ionic and anionic surfactants. This situation indicates that biodegradable products are in use in Italy, as required by existing regulations. These results agree with those obtained by this research team in 1973, when despite drastically increased detergent consumption, surfactant concentration levels had not significantly risen since 1964.

*Waste water treatment, *Pollutant identification, *Sewage treatment, *Activated sludge, *Sewerage, Treatment facilities, Degradation, Surfactants

E057

RESIDUAL ORGANIC MATTER IN ACTIVATED SLUDGE PROCESS EFFLUENTS VIII. SEPARATION BY MOLECULAR WEIGHTS ON SEPHADEX COLUMNS (Zbytkove latky po aktivacnim procesu VIII. Deleni podle molekulovych hmotnosti na sephadexech),

Chudoba, J., Lischke, P., Tucek, F., and Maglicova, A.

Katedra technologie vody a prostredi VSCHT,
Praha, Czechoslovakia.

Scientific Papers of the Institute of Chemical Technology, Prague, F 19 (1974)
Technology of Water. 15 fig, 6 tab, 26 ref.

Residual organic compounds found in biologically purified waste waters were fractionated by means of gel chromatography on Sephadex columns. The first sample treated was a concentrate of the residual compounds from a laboratory activated sludge unit using a mixture of glucose and glutamic acid as the substrate; it contained only the compounds produced by the activated sludge microorganisms. Sample 2 was a concentrate of the residual compounds from biologically treated Prague sewage. Sample 3 was a concentrate of trace organic compounds from Prague tap water, which were not removed by the coagulation process in the water treatment plant. Six percent of the compounds in the first sample had molecular weights (MW) greater than 50,000, and 78% had MW lower than 700. Sample 2 contained no compounds with MW above 50,000, 5% compounds with MW between 10,000 and 50,000, and 77% compounds with MW below 700. Thirteen percent of the compounds in sample 3 had MW between 10,000 and 50,000, and 77% had MW below 700. Previous conclusions are discussed in the light of these findings. Coagulation tests verified the theoretical conclusion that, since about 75% of the residual organic compounds have MW below 700, they cannot be removed from the solution by the usual coagulation process. The maximum chemical oxygen demand (COD) removal for various samples varied between 23% and 29%.

*Waste water treatment, *Pollutant identification, *Organic compounds, *Analytical techniques, *Molecular structure, *Weight, Sewage treatment, Biological treatment, Activated sludge, Sewerage, Chemical oxygen demand, Treatment facilities

*Molecular weight

E058

RESIDUAL ORGANIC MATTER IN ACTIVATED SLUDGE PROCESS EFFLUENTS. IX. ISOLATION FROM WATER, FRACTIONATION ON ALUMINUM OXIDE COLUMNS AND ATTEMPTS OF IDENTIFICATION (Zbytkove latsy po aktivacnim procesu. IX. Izolace z vodneho prostredi, deleni na kyslicniku hlinitem a pokusy o identifikaci),

Chudoba, J., Tucek, F., Lischke, P., Dousa, A., and Kubelka, V.

Katedra technologie vody a prostredi VSCHT,
Praha, Czechoslovakia.

Scientific Papers of the Institute of Chemical Technology, Prague, F 19 (1974)
Technology of Water. 8 fig, 16 tab, 44 ref.

Residual organic compounds prepared in a laboratory activated sludge unit fed with glutamic acid and glucose were concentrated, separated from inorganic salts, and fractionated on aluminum oxide columns. Individual compounds were identified by examining fractionated groups using a gas chromatograph-mass spectrometer technique. Sixty-five percent of the chemical oxygen demand (COD) was adsorbed from the effluent of the activated sludge unit when desalination was carried out using a strongly acid cation-exchange resin and a weakly basic anion-exchange resin. When inorganic compounds were precipitated with ethanol and an ethanol and acetone mixture, 61% of the COD entered the precipitate. The extract obtained with ether after the first desalination was shown by fractionation to contain at least five compounds. The main portion of the compounds not extractable by ether was fractionated by gradient elution and contained 14 groups of compounds. At least three compounds were obtained by combining and refractionating the lesser polar compounds. Four derivatives of benzothiazole substituted in the position 2, benzothiofene and its two derivatives, indanone, difenylamine, di-N-probylaniline, nitrophenoles, methylisopropyl phenol, and several other compounds with uncertain structures were identified on the basis of mass spectra. Residual organic compounds originating as waste products of activated sludge microorganisms represent a varied mixture, from less polar to highly polar.

E059
POLLUTANT ANALYSIS COST SURVEY,

Greiler, B., and Taylor, J. K.

United States Department of Commerce,
Washington, D. C.,
National Bureau of Standards.

1974, 196 p. 4 fig, 30 tab, 186 ref. Publication No. PB-241 991.

Various approaches to chemically analyzing heavy industrial process materials and effluents for trace elements possibly contributing to environmental pollution are summarized. The costs and capabilities of nuclear methods, spark source spectrometry, atomic absorption spectrometry, voltammetry, and potentiometry are assessed for determining traces of mercury, beryllium, cadmium, arsenic, vanadium, manganese, nickel, antimony, chromium, zinc, copper, lead, selenium, boron, fluorine, lithium, silver, tin, iron, strontium, sodium, potassium, calcium, silicon, magnesium, uranium, and thorium in matrices such as fly ash, oil, coal, ores, minerals, metals, organometallics, alloys, slurry streams, incinerator particulates, and feeds of sedimentation processes. A selected bibliography is included and the Standard Reference Materials available for environmental analysis are reviewed. This report revises and extends the 'Survey of Various Approaches to the Chemical Analysis of Environmentally Important Materials,' which it supersedes.

*Pollutant identification, *Water pollution, *Industrial wastes, *Testing, *Cost analysis, Spectrophotometry, X-ray fluorescence, Spectroscopy

Emission spectroscopy, Electron probes, Polarography

E060
WATER POLLUTION SAMPLER EVALUATION,

Barkley, J. J., Jr., Peil, K. M., and Highfill, J. W.

Army Medical Bioengineering Research and
Development Laboratory,
Fort Detrick, Maryland.

1975, 162 p. 24 fig, 39 tab, 6 ref, 5 append. Technical Report ADA-009-079.

Standardized solutions and testing procedures for evaluating water and waste water samplers were studied. The ability of existing portable samplers to obtain representative samples of various waste water constituents under various physical limitations was evaluated. Sixteen samplers, representing the various types available, were tested with synthetic waste waters consisting of six classes of naturally occurring constituents. Test physical constraints included lift, temperature, and sampling duration. Samplers were evaluated as to ease of operation, representativeness of sample, and relation to a predefined ideal sampler and ranked as to overall performance. Only refrigerated samples maintained the level of biodegradable material. Gas-operated samplers inhibited bacterial viability in the sampled media, either because of the Freon or the grease associated with Freon. Collection velocity, constrictions, reductions or tees in the flow system, and screens or small holes in the inlet device influence the ability of a sampler to collect suspended solids. Temperature, time, and lift apparently do not significantly affect the collection or maintenance of colloids. No sampler was found efficient for sampling dissolved oxygen. Non-repeatable results were obtained for the volatile organic class, possibly due to the fact that ambient temperature was not controlled and shortcomings in the analytical procedure. Self-purging samplers were generally more efficient than non-purging models.

*Pollutant identification, *Analytical techniques, *Instrumentation, *Sanitary engineering, *Water sampling, Laboratory tests, Testing procedures, Publications

E061

EFFECT OF WASTEWATER COMPOSITION AND CELL RESIDENCE TIME ON PHOSPHORUS REMOVAL IN ACTIVATED SLUDGE,

Stall, T. R., and Sherrard, J. H.

Phillips Petroleum Company, Incorporated,
Bartlesville, Oklahoma.

Journal Water Pollution Control Federation, Vol. 48, No. 2, p 307-322, February, 1976. 8 fig, 4 tab, 23 ref.

A bench-scale activated sludge unit was operated under closely controlled conditions to study the influence of mean cell residence time and stoichiometric relationships on phosphorus removal. It was operated on a batch basis until the solids concentration reached approximately 1,500 mg/liter, then switched to continuous flow operating conditions. The initial seed of microorganisms was taken from a well-operating experimental activated sludge system. The raw feed solution was tested for chemical oxygen demand, total phosphate phosphorus and pH; the unfiltered effluent for total phosphate-phosphorus, pH, and suspended solids; filtered effluent for COD and soluble phosphate-phosphorus; and the biological reactor for aeration basin ss, total system microorganisms concentration, temperature, and pH. Phosphorus removal efficiencies were higher when mean cell residence time was lower. At any given mean cell residence time, larger COD:phosphorus ratios produced higher phosphorus removal efficiencies. The phosphorus content of the sludge varied between 2.21% and 3.63% on a dry weight basis. Phosphorus removal efficiency and sludge production are directly related. The effective phosphorus removal efficiency is significantly reduced by solids carry-over in the effluent. Biological phosphorus removal may be predicted closely if the cellular phosphorus content and the sludge production are estimated reasonably. Phosphorus may become a limiting nutrient at high COD:phosphorus ratios and low sludge ages, whereas COD is limiting at a high sludge age.

*Waste water treatment, *Biological treatment, *Activated sludge, *Chemical oxygen demand, *Phosphorus, Phosphates, Hydrogen ion concentration, Suspended solids, Microorganisms, Temperature, Analytical techniques

Cell residence time

E062

ANALYZING FOR ASBESTOS IN DRINKING WATER,

Millette, J. R.

Municipal Environmental Research Laboratory,
Cincinnati, Ohio,
Water Supply Research Division.

News of Environmental Research in Cincinnati, p 1-4, January 16, 1976. 4 fig.

Although the health effects of asbestos fibers in drinking water currently are not known, sufficient concern exists that the levels should be investigated. An electron microscope is used for routine asbestos analysis because it can be used to identify fibers by crystal structure, morphology, and elemental composition. Samples from throughout the country were analyzed, indicating that a few municipal water supplies have relatively high asbestos levels, and that water with certain chemical characteristics may cause asbestos fibers to be released from asbestos cement pipe into water systems.

*Pollutant identification, *Analytical techniques, *Asbestos, *Potable water, *Electron microscopy, Asbestos cement, Public health, Concrete pipes, Water conveyance

E063

IMPORTANT ASPECTS OF PHOSPHORUS ANALYSIS,

Zuern, H. E.

Allied Chemical Corporation,
Morristown, New Jersey.

Water and Sewage Works, Reference number, p R-52-R-53, April 30, 1976. 1 ref.

Methods for the analysis of phosphorus in waste water are reviewed. All poly and organic phosphates must first be converted to ortho phosphate in order to determine the phosphorus content of a waste water sample. This is done by digesting the sample through chemical addition and heating. Three digestion techniques are suggested in Standard Methods: perchloric acid, sulfuric-nitric acid, and persulfate. The persulfate method is recommended for most waste water laboratories since it involves minimum hazards. After the digestion procedure, samples are checked for clarity to determine if filtering or centrifuging is necessary prior to colorimetric phosphorus determination. Suitable colorimetric methods include: the stannous chloride method which has a useful range of 0.007-2.0 mg/liter, the ascorbic acid method which has a useful range of 0.03-2.0 mg/liter, and the vanadomolybdophosphoric method which has a useful range of 0.75-20 mg/liter. The last method requires only one chemical for color development and is suitable for most field work where minute accuracy is not required. The stannous chloride method is preferred when small quantities of phosphorus (less than 2.0 mg/liter) are to be determined.

*Phosphorus, *Analytical techniques, *Colorimetry, *Pollutant identification, *Waste water (pollution), Organophosphorus compounds, Phosphates

Ortho phosphate, Poly phosphates, Sample preparation, Digestion techniques

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E064

FLUCTUATIONS OF THE RUNOFF OF TWO ACTIVATED SLUDGE PLANTS AND ITS CONSEQUENCES FOR THE OBSERVANCE OF LIMIT VALUES (SCHWANKUNGEN DER ABLAEUFE ZWEIER SCHLAMMBELEBUNGSANLAGEN UND INRE KONSEQUENZEN FUER DIE EINHALTBARKEIT VON GRENZWERTEN),

Frenzel, H-J., and Sarfert, F.

Gas-und Wasserfach-Wasser/Abwasser, Vol. 117, No. 3, p 123-128, 1976. 10 fig, 6 ref.

The BOD5 value, the KMnO4 consumption, the total nitrogen content and the phosphate content were measured in the purified effluent from a low-loaded biological waste water treatment plant and from a normally loaded pilot plant in a study on the possibility of observing the limiting values according to Poepel's concept. The BOD5 level, the KMnO4 consumption and the dry matter content were lower in the effluent from the low-leaded treatment plant, while the phosphate content was higher due to the limited mineralization of the activated sludge at the low sludge BOD5 level of about 0.1 kg/kg x day. It was impossible to adopt a limit value which is never exceeded. The compliance with the limit value can be determined by a limited random sampling rather than daily checks.

*Waste water treatment, *Biological treatment, *Activated sludge, *Biochemical oxygen demand, *Treatment facilities, Potassium compounds, Nitrogen, Phosphates

Dry matter content

E065

FLOW OF TOXIC METALS IN THE ENVIRONMENT,

Jenkins, D. W.

Pan American Health Organization,
Mexico City, Mexico.

In: International Conference on Environmental Sensing and Assessment, Vol. 1, September 14-19, 1975, Las Vegas, Nevada, p 1-1-1 - 1-1-5. 2 fig, 5 tab, 22 ref.

The various pathways and flows of twelve toxic metals through the air, terrestrial ecosystems, freshwater, and the ocean are outlined. Pathways relevant to water pollution include: washout and deposition from the atmosphere, leaching and sewage disposal from terrestrial ecosystems to fresh water, the flow of fresh water via rivers and estuaries to the ocean, and the direct dumping of wastes via ocean outfalls. Each environmental compartment has metals flowing in and out of it, with the exception of the ocean. The ocean receives large amounts of toxic metals, but only a small portion of these metals leave in the form of marine products. Oceanic levels of antimony, arsenic, cadmium, chromium, cobalt, copper, lead, mercury, nickel, tin, vanadium, and zinc are estimated at 617, 2740, 27, 55, 685, 1370, 55, 137, 2740, 4110, 2740, and 13,700 million tons, respectively. The amounts of these metals added to the ocean annually as a result of river flow and atmospheric washout are also tabulated. Maximum enrichment factors of marine organisms are also presented.

*Metals, *Toxicity, *Surface waters, *Ecosystems, *Water pollution effects, *Groundwater, Oceans, Rivers, Estuaries, Waste disposal, Arsenic compounds, Cadmium, Chromium, Cobalt, Copper, Lead, Mercury, Nickel, Zinc, Washouts, Leaching

Antimony, Tin, Vanadium, Enrichment factors

E066

SAMPLING AND ANALYSIS OF METALS IN AIR, WATER AND WASTE PRODUCTS,

Morgan, J. J.

California Institute of Technology,
Pasadena, California,
W. M. Keck Laboratories of
Environmental Engineering Science.

In: International Conference on Environmental Sensing and Assessment, Vol. 1, September 14-19, 1975, Las Vegas, Nevada, p 1-2-1 - 1-2-9, 4 tab, 83 ref.

Monitoring, sampling, and analytical procedures for different environmental compartments are reviewed from the standpoint of source-flow-receptor and chemical element balance concepts. Levels of various metals in drinking water, surface waters, sewage effluent, and sewage sludge are compared. Standard, tentative, and approved analytical methods are reviewed for the analysis of metals in water along with methods for collection, preconcentration, and sample preparation. The effects of sampling, storage, processing, and preconcentration steps on the overall analysis of water samples containing metals are also discussed. Analytical methods such as instrumental neutron activation analysis, X-ray fluorescence, flame and non-flame atomic absorption, plasma emission spectrometry, and spark source mass spectrometry are reviewed in terms of their accuracy and range of use. The need for advancements in chemical speciation is discussed in terms of the effects of particular metals on aquatic life.

*Pollutant identification, *Metals, *Sampling, *Analytical techniques, Neutron activation analysis, X-ray fluorescence, Mass spectrometry, Potable water, Surface waters, Sewage, Sludge, Aquatic life

Atomic absorption spectrometry, Plasma emission spectrometry

E067
MONITORING: THE TRIGGER FOR ACTION,

Wallen, I. E.

U.S. Environmental Protection Agency,
Washington, D. C.,
Office of Toxic Substances.

In: International Conference on Environmental Sensing and Assessment, Vol. 1, September 14-19, 1975, Las Vegas, Nevada, p 2-1-1 - 2-1-3.

Environmental Protection Agency air and water monitoring programs are reviewed. The programs include the monitoring of drinking water for organics that are suspected carcinogens, the monitoring of industrial waste waters for asbestos, early warning efforts to screen water samples from industrial areas for toxic organic and inorganic compounds, and a project to identify multimedia exposure to selected halogenated organics in air, water, soil, and food as well as the levels of these chemicals in human populations throughout an exposure area. A survey of 80 drinking water supplies has already established the possibility that chlorination may be contributing to the formation of halomethanes in drinking water. The use of monitoring data in setting standards is also discussed.

*Monitoring, *Programs, *Water quality, *Pollutant identification, *Water treatment, Chlorination, Industrial wastes, Potable water, Organic compounds, Asbestos, Inorganic compounds, Chemical reactions, Standards, Surveys

Halogenated organics, Halomethanes

E068
ENVIRONMENTAL LEVELS OF PCB'S,

Ruopp, D. J., and DeCarlo, V. J.

U.S. Environmental Protection Agency,
Washington, D. C.

In: International Conference on Environmental Sensing and Assessment, Vol. 1, September 14-19, 1975, Las Vegas, Nevada, p 2-3-1 - 2-3-5. 1 fig, 4 tab, 35 ref.

Data from national surveys of environmental levels of polychlorinated biphenyls are presented. Surface water and groundwater levels throughout the United States range from 0.1-4.0 micrograms/liter, and levels in fish range from 0.10-14.8 ppm. On the basis of national aquatic environmental data collected in 1971-1972 and in 1974, a continuing widespread accumulation of polychlorinated biphenyls in water, sediment, and fish appears to be occurring. A human monitoring program in 1972 revealed that 3035 out of 4102 samples of human adipose tissue showed levels ranging from less than one ppm to more than 3 ppm. In 1973, 964 out of 1277 samples from 28 states again showed levels in the same range. The major sources contributing to the environmental levels of polychlorinated biphenyls appear to be industrial effluents, manufacturing processes, consumer and industrial waste materials, sewage treatment facilities, and accidental spills.

*Polychlorinated biphenyls, *Water pollution, *Water pollution effects, *Monitoring, Fish, Pollutant identification, Surveys, Surface waters, Groundwater, Industrial wastes, Sewage, Treatment facilities, Effluents, Human population

E069
A PRELIMINARY DESIGN FOR A NATIONAL ENVIRONMENTAL CENSUS,

Rosen, R. H., and Beck, R. P.

Energy Resources Company, Incorporated,
Cambridge, Massachusetts.

In: International Conference on Environmental Sensing and Assessment, Vol. 1, September 14-19, 1975, Las Vegas, Nevada, p 3-2-1 - 3-2-3. 3 tab, 6 ref.

Present and future requirements for pollution control expenditures in the United States are reviewed, and a national environmental census designed to overcome inadequacies of the present monitoring system is proposed. The capital investment for water pollution control is expected to exceed $80 billion between now and 1982. Although over 5453 water monitoring stations presently exist, which is more than enough to meet the nation's needs, a lack of rational distribution of monitoring facilities is evidenced by the fact that 10 of the 50 states have less than half of the number of monitoring stations required to represent the population. A national environmental census is proposed as a solution to the distribution problem. The census is expected to cost between 68 and 104 million dollars/year for water monitoring.

*Monitoring, *Water quality, *Costs, *Census, Economics, Water pollution control, Evaluation, Projections, Design criteria

National environmental census

E070
DESIGN OF NATIONWIDE WATER-QUALITY MONITORING NETWORKS,

Pickering, R. J., and Ficke, J. F.

U. S. Geological Survey,
Reston, Virginia,
National Center.

In: International Conference on Environmental Sensing and Assessment, Vol. 1, September 14-19, 1975, Las Vegas, Nevada, p 3-3-1 - 3-3-4. 2 fig, 5 ref.

Design criteria for water quality monitoring networks are discussed, and the United States Geological Survey's National Stream Quality Accounting Network is described. Specific objectives of a monitoring program must be defined before a proper mix of sampling sites, frequency of measurement, and characteristics to be measured can be selected. Design of groundwater quality networks, for example, must be based on knowledge of direction and rate of water movement, while proper sampling in streams requires a knowledge of velocity distribution in the cross section and expected variation in streamflow and water quality with time. A National Stream Quality Accounting Network which subdivides the United States into 325 hydrologic accounting units is being designed by the Geological Survey to provide a measure of the quality of the Nation's rivers. Reports from the network will describe geographic and annual variations in streamflow and water quality, their probable causes, and detectable long-term trends. Organic and radioactive substances and biological characteristics will be measured at selected network stations that constitute subnetworks of the National Stream Quality Accounting Network.

*Monitoring, *Water quality, *Network design, *Pollutant identification, Groundwater, Surface waters, Rivers, Design criteria, Networks, Biological properties, Organic compounds, Radioactive wastes

National Stream Quality Accounting Network

E071
SOME INTERNATIONAL ACTIVITIES IN ENVIRONMENTAL MONITORING,

Ozolins, G.

World Health Organization,
Geneva, Switzerland.

In: International Conference on Environmental Sensing and Assessment, Vol. 1, September 14-19, 1975, Las Vegas, Nevada, p 3-4-1 - 3-4-4.

A review of international environmental monitoring activities is presented. The World Health Organization is providing direct assistance to less developed countries for the establishment of drinking water surveillance programs and is preparing a training manual for this purpose. The Food and Agriculture Organization is involved in providing technical assistance and guidance on the development of water quality monitoring programs for commercial fisheries and is also pursuing monitoring projects related to agriculture, particularly irrigation waters. The United Nations Educational, Scientific and Cultural Organization is concentrating on the coordination of the International Hydrological Decade and the International Hydrological Program and is preparing a guidebook for water quality surveys. The Intergovernmental Oceanographic Commission, the Intergovernmental Maritime Consultative Organization, and other organizations are involved in studying pollution of oceans and the seas. The World Health Organization is involved in surface water monitoring activities and is giving assistance to Member States in developing national water pollution monitoring programs. The World Meteorological Organization is primarily directing its monitoring activities towards operational hydrology.

*Monitoring, *Water quality, *International commissions, *Programs, International hydrological decade, Potable water, Surface waters, Oceans, Sea water, Irrigation water, Surveys, Hydrology, Fisheries

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E072
EARTHWATCH-SENTINEL FOR THE FUTURE,

Jensen, C. E., and Brown, D. W.

National Oceanic and Atmospheric
Administration,
Rockville, Maryland.

In: International Conference on Environmental Sensing and Assessment, Vol. 1, September 14-19, 1975, Las Vegas, Nevada, p 3-5-1 - 3-5-3.

The global environmental assessment program, EARTHWATCH, is described. This program is part of the United Nations Environment Program and calls for the establishment of World Environmental Assessment Centers and Regional Environmental Assessment Centers which in turn are supported by national facilities. EARTHWATCH Reference Sites are to be established for providing an integrated base of benchmark data and information and will include selections from ongoing and planned activities dealing with hydrology stations, lake biome programs, open ocean baseline sites, and river outflow stations. Impact sites will provide a continuing, systematic appraisal of immediate and near-term environmental impacts and will include programs dealing with regional marine monitoring activities. An EARTHWATCH Indicator Program will begin with the designation of a series of target substances or organisms to be included in reference and impact monitoring activities. Three pilot projects are also proposed.

*Monitoring, *Water quality, *Water pollution effects, *Baseline studies, *Environmental effects, Programs, Oceans, Lakes, Hydrology, Data collections, Information exchange, Indicators, Pollutant identification, Fish

EARTHWATCH

E073
NETWORK DESIGN CONSIDERATIONS FOR THE GLOBAL ENVIRONMENTAL MONITORING SYSTEM (GEMS) OF THE UNITED NATIONS,

Citron, R.

In: International Conference on Environmental Sensing and Assessment, Vol. 1, September 14-19, 1975, Las Vegas, Nevada, p 3-6-1 - 3-6-6. 6 tab, 22 ref.

Worldwide existing and planned environmental monitoring programs are surveyed in connection with a Global Environmental Monitoring System being developed by the United Nations. One of the first priorities of the System is to coordinate and support monitoring programs that provide information on the states and trends of global pollution. At least 160 programs operating over 10,000 sites in 44 countries are currently monitoring toxic heavy metals and chlorinated hydrocarbons in air, fresh water, marine water, drinking water, soil, plants, food, animals, and man. More than 50 programs over 3500 sites are monitoring these pollutants in North America. On a worldwide basis, 145 marine water programs, 278 fresh water programs, 48 drinking water programs, 9 rain programs, and 2 sewage programs are operating over 15,837, 32,246, 6440, 232, and 18 sites, respectively, for monitoring the biological and chemical properties of these media.

*Monitoring, *Networks, *Water quality, *Pollutant identification, Programs, Heavy metals, Organic compounds, Chemical properties, Biological properties, Potable water, Sea water, Rain, Freshwater, Sewage

Chlorinated hydrocarbons

E074
POLYCHLORINATED BIPHENYLS OFF SOUTHERN CALIFORNIA,

Young, D. R., McDermott, D. J., and Heesen, T. C.

Southern California Coastal Water Research Project,
El Segundo, California.

In: International Conference on Environmental Sensing and Assessment, Vol. 1, September 14-19, 1975, Las Vegas, Nevada, p 4-1-1 - 4-1-5. 6 fig, 2 tab, 10 ref.

Data on polychlorinated biphenyl contamination of the marine ecosystem off southern California are presented. Municipal waste water and aerial fallout dominate the known inputs of polychlorinated biphenyls to the southern California bight. More than 5 metric tons of 1242 and 1254 polychlorinated biphenyls were discharged during 1974 from the five major treatment plants in the area. Maximum concentrations of biphenyl found in bottom sediments off Palos Verdes Peninsula were 10 ppm, with values falling 100-fold to baseline readings over a depth of 20 cm. Muscle tissue from benthic crabs and flatfish collected from discharge regions also exhibited 100-fold increases in 1254 polychlorinated biphenyl levels. Numerous harbors in the bight also show relatively high levels of polychlorinated biphenyl contamination. Intertidal bay mussels contained up to 20 times more 1254 biphenyl than corresponding specimens collected nearby along the open coast. An offshore biomonitoring system which utilizes the intertidal coastal mussel (M. californianus) has been developed. This mussel appears to offer good potential for indicating zones of greatest biological availability of synthetic pollutants released from submarine outfalls.

*Polychlorinated biphenyls, *Water pollution, *Water pollution effects, *California, *Coasts, Pollutant identification, Treatment facilities, Waste water treatment, Municipal wastes, Outlets, Marine animals, Monitoring, Bioindicators, Crabs, Mussels, Fish, Sediments, Harbors

Chlorinated hydrocarbons, Bights, Flatfish

E075

WATER CONTAMINATION DETECTION,

Lysyj, I.

Rockwell International,
Canoga Park, California,
Rocketdyne Division.

In: International Conference on Environmental Sensing and Assessment, Vol. 1, September 14-19, 1975, Las Vegas, Nevada, p 4-2-1 - 4-2-3. 4 tab, 4 ref.

The feasibility of using pyrographic analysis for detecting gross discharges and spills of waste materials into open waters and for monitoring gross changes in the quality of the receiving water was evaluated. Pyrographic analysis involves subjecting the water sample to elevated temperatures so that the organics in the water are pyrolyzed. The pyrolysis gases are then separated by gas chromatography and detected as a series of peaks by a flame ionization detector. A field study in the Occonee River in Georgia demonstrated that pyrographic patterns of discharged waste were different from pyrographic patterns of natural unpolluted waters, providing a means for determining general or gross water quality of a receiving stream. A method of developing a scale of relative septicity as an indicator of gross water quality was also presented.

*Analytical techniques, *Water quality, *Organic compounds, *Gas chromatography, *Waste water (pollution), Surface waters, Feasibility studies, Evaluation, Measurement, Rivers, Effluents

Pyrographic analysis

E076

SPARK SOURCE MASS SPECTROMETRY: THE OPTIMUM REFEREE METHOD FOR MULTIELEMENT ANALYSIS,

Taylor, C. E.

U.S. Environmental Protection Agency,
Athens, Georgia,
Environmental Research Laboratory.

In: International Conference on Environmental Sensing and Assessment, Vol. 1, September 14-19, 1975, Las Vegas, Nevada, p 4-4-1 - 4-4-2. 2 fig.

The use of spark source mass spectrometry for the multielement analysis of water samples is discussed. The method can be used to routinely yield data on up to 82 elements simultaneously at the parts per billion level. The operating parameters for the instrumentation are constant for all samples, thus eliminating the need for optimization procedures. A comparison of spark source mass spectrometric analyses with those of instrumental neutron activation analysis, plasma emission, atomic absorption, and X-ray fluorescence revealed unexpected errors in the latter methods associated with the complex and variable matrices of environmental samples.

*Mass spectrometry, *Pollutant identification, *Water quality, *Analytical methods, X-ray fluorescence, Neutron activation analysis, Measurement, Performance, Evaluation

Multi-element analysis, Trace analysis, Atomic absorption spectrometry, Plasma emission spectrometry

E077
TRACE METAL ANALYSIS BY ATOMIC EMISSION USING A D.C. ARGON PLASMA,

Cox, W. G.

Naval Underwater System Center,
Newport, Rhode Island,
Material and Chemistry Branch.

In: International Conference on Environmental Sensing and Assessment, Vol. 1, September 14-19, 1975, Las Vegas, Nevada, p 4-6-1 - 4-6-4. 2 fig, 12 ref.

The use of direct current argon plasma atomic emission spectrometry for the analysis of trace metals in water samples is discussed. The method utilizes an Echelle grating spectrometer with a direct current argon plasma to achieve high resolution, high luminosity, and wide spectral coverage. Matrix effects which have traditionally plagued atomic absorption techniques are minimized or eliminated. Calculated detection limits for mercury, lead, cadmium, zinc, copper, and chromium in sea water samples were 57, 35, 12, 12, 6, and 8 micrograms/liter, respectively, using the argon plasma atomic emission technique. The overall acquisition and maintenance costs of the system are comparable to those for an atomic absorption system.

*Spectrophotometry, *Argon, *Analytical techniques, *Pollutant identification, *Metals, Water quality, Sea water, Mercury, Lead, Cadmium, Zinc, Copper, Chromium, Costs, Evaluation, Performance, Measurement

Atomic emission spectrometry, Plasma atomic emission spectrometry

E078
AN EVALUATION OF AUTOMATIC WASTEWATER COMPOSITORS,

Harris, D. J., and Keffer, W. J.

Environmental Protection Agency,
Kansas City, Kansas,
Surveillance and Analysis Division.

In: International Conference on Environmental Sensing and Assessment, Vol. 1, September 14-19, 1975, Las Vegas, Nevada, p 4-7-1 - 4-7-5. 3 tab, 2 ref.

Results from field evaluations of automatic waste water samplers are presented, and field compliance monitoring procedures used by the Environmental Protection Agency are reviewed. Comparison studies of various commercial waste water samplers at four sewage treatment plants indicated variations in water chemistry data which were greater than could be explained by laboratory analytical error. Samplers which produced the highest concentrations of solids had higher liquid intake velocities. Slower acting peristaltic and piston pump type samplers appeared to be either not capturing settleable materials or were exhibiting higher settling velocities than liquid intake velocities after introduction to the intake line. High vacuum sampling equipment is used by the Environmental Protection Agency on waste sources with appreciable concentrations of large and/or heavy settleable material such as raw municipal waste water since this type of sampling equipment appears to produce more representative samples.

*Sampling, *Equipment, *Waste water (pollution), *Monitoring, *On-site tests, Evaluation, Performance, Treatment facilities, Waste water treatment, Instrumentation, Municipal wastes, Sewage treatment

E079

SOME CONSIDERATIONS ON MONITORING OF TRACE METALS IN ESTUARIES AND OCEANS,

Segar, D. A., and Cantillo, A. Y.

National Oceanic and Atmospheric Administration,
Miami, Florida,
Atlantic Oceanographic and Meteorological Laboratories.

In: International Conference on Environmental Sensing and Assessment, Vol. 1, September 14-19, 1975, Las Vegas, Nevada, p 6-5-1 - 6-5-5. 3 fig, 1 tab, 13 ref.

The trace metal chemistry of the coastal waters of New York and New Jersey in the vicinity of the Hudson-Raritan river discharge was studied. Contamination-free samples were obtained using a 'top drop' Niskin bottle and a rosette multi-sampler. Analysis was performed by flameless atomic absorption spectrophotometry. Large geographical and short-term temporal variations in dissolved trace metal content were observed. Intensive sampling in a restricted geographical area also revealed the existence of coherent cells of water which contained anomalously high metal concentrations. The geographical location of these cells suggested that they were caused by the river discharge influence and by sewage sludge or dredge spoil dumping. An appreciable fraction of the metal present in the dissolved phase of the New York Bight could not be determined by traditional analytical techniques such as solvent extraction. Continuous real-time horizontal profiling of trace metal concentrations from a moving vessel appears to be required for adequately describing the processes affecting metal introduction, transport, and removal in the area. Data on the percentage of total dissolved copper and iron which is determinable by solvent extraction and atomic absorption are presented along with vertical distributions of total zinc.

*Metals, *Estuaries, *Oceans, *Pollutant identification, *Analytical techniques, Sampling, Rivers, Sewage sludge, Dredging, Zinc, Copper, Iron, Separation techniques, Coasts, New York, New Jersey

Atomic absorption spectrophotometry, Bights, Dredge spoil dumping

E080

ENVIRONMENTAL MONITORING IN LATIN AMERICA AND THE CARIBBEAN,

Haddad, R., and Castagnino, W.

Pan American Health Organization,
Pan American Center for Sanitary Engineering and
Environmental Sciences.

In: International Conference on Environmental Sensing and Assessment, Vol. 1, September 14-19, 1975, Las Vegas, Nevada, p 8-1-1 - 8-1-7. 4 fig, 5 tab, 13 ref.

Water pollution monitoring activities in Latin America and the Caribbean are reviewed. Most countries in the region have been collecting water quality information for several decades with varying degrees of coverage. An example of studies being performed to evaluate basin-wide water quality is the Pan American Health Organization report on "Water Quality in the Plata River Basin." This study includes the monitoring of dissolved oxygen, biochemical oxygen demand, and coliform level in the Matanza River (Buenos Aires area); assessing the influence of Bermejo River solid load discharge into the Parana River system; and bacterial pollution monitoring in the Guaiba River (Porto Alegre area). Studies designed to predict future water quality and the degree of pollution control required for meeting specific socio-economic needs are also being conducted. An example is the Guanabara Bay modelling effort and its monitoring requirements.

*Monitoring, *Water quality, *Pollutant identification, *Rivers, *Model studies, Dissolved oxygen, Biochemical oxygen demand, Coliforms, Bacteria, Solid wastes

Latin America, Caribbean

E081

ENVIRONMENTAL QUALITY SURVEILLANCE IN INDONESIA,

Soesanto, S. S.

Ministry of Health,
Jakarta, Indonesia,
National Institute of Health,
Research and Development.

In: International Conference on Environmental Sensing and Assessment, Vol. 1, September 14-19, 1975, Las Vegas, Nevada, p 8-7-1 - 8-7-4. 1 tab, 1 ref.

Water quality monitoring data are presented for Indonesia. Rivers and storm water canals in Jakarta show biochemical oxygen demand levels ranging from 100-200 ppm; dissolved oxygen often drops to 0 ppm. An assessment of the bacteriological quality of raw water taken from the storm water canal for the Jakarta Water Treatment Plants shows a mean probability number of 500,000-2,000,000/100 ml. Biochemical oxygen demand values as high as 1000 ppm exist in the Pluit reservoir which is located near the sea where industrial wastes are discharged. Saline water intrusion is a problem in some coastal areas such as the northern coast of Java and the southern coast of Kalimantan. Water pollution from fertilizer plant wastes exists in South Sumatera, and East Java is experiencing water pollution problems as a result of petrochemical wastes.

*Monitoring, *Water quality, *Pollutant identification, *Industrial wastes, Waste water treatment, Treatment facilities, Rivers, Coasts, Biochemical oxygen demand, Dissolved oxygen, Bacteria, Saline water intrusion, Sea water, Reservoirs

Indonesia

E082

A STRATEGY FOR AQUATIC POLLUTANTS FATE AND TRANSPORT DETERMINATION,

Sanders III, W. M.

U.S. Environmental Protection Agency,
Athens, Georgia,
Environmental Research Laboratory.

In: International Conference on Environmental Sensing and Assessment, Vol. 1, September 14-19, 1975, Las Vegas, Nevada, p 14-7-1 - 14-7-5. 1 tab, 25 ref.

A strategy developed by the Environmental Protection Agency for obtaining transport and fate information for aquatic pollutants is outlined. Studies are first conducted to determine whether degradation or transformation reactions occur and if their rates are fast enough to be environmentally significant. If the results are positive, detailed mechanistic and kinetic studies are then conducted. A final evaluative phase of the strategy involves observing the results of various competing or enforcing reactions. The various rate processes are described mathematically, and the resulting equations are coupled to form evaluative computer models. These models do not represent any particular aquatic system but are structured so that each important environmental factor can be varied within the ranges observed in nature. The model results can be presented as concentration and distribution profiles for parent compounds and for degradation products. Applications of the modeling strategy involving the prediction of vinyl chloride half-life in lake and river ecosystems and the degradation of the organophosphorus pesticide malathion in a river ecosystem are described.

*Model studies, *Water quality, *Chemical degradation, *Kinetics, *Water pollution effects, Chemical reactions, Chemical properties, Rivers, Lakes, Organophosphorus pesticides, Chlorides, Computer programs

Malathion, Vinyl chloride, Chlorinated hydrocarbons, Transformation

E083

REMOTE SENSING OF GROUND AND SURFACE WATER CONTAMINATION BY LEACHATE FROM LANDFILL,

Sangrey, D. A., Teng, W. L., Philipson, W. R., and Liang, T.

Cornell University,
Ithaca, New York,
School of Civil and Environmental Engineering.

In: International Conference on Environmental Sensing and Assessment, Vol. 1, September 14-19, 1975, Las Vegas, Nevada, p 15-1-1 - 15-1-5. 2 fig, 2 tab, 2 ref.

The feasibility of using remote sensing procedures for detecting and evaluating ground and surface water contamination by landfill leachate was evaluated at 15 landfill sites in central New York. Aircraft flights and ground sampling were performed at key times during a one-year period, and the aerial data included color and color infrared photography and thermal infrared imagery. Each type of remote sensing proved to be useful to some extent, and the combination of color and color infrared photography was the most effective system. Wetness, discoloration of land and surface waters, and vegetative stress were useful ground characteristics imaged by the remote sensors. In no case were they uniquely indicative of leachate; however, in association with landfill, they defined prime areas for more detailed study and ground level confirmation. No methods were found for quantitatively defining leachate. Remote sensing was most effective during wet periods in early spring.

*Remote sensing, *Aerial photography, *Infrared radiation, *Water pollution, *Landfills, *Leachate, On-site investigations, Feasibility studies, Evaluation, Performance, Photography, Analytical techniques, Groundwater, Surface waters

Thermal infrared imagery

E084

A PROPOSED NATIONAL MONITORING SYSTEM FOR ORGANICS IN WATER,

McGuire, J. M.

U.S. Environmental Protection Agency,
Athens, Georgia,
Environmental Research Laboratory.

In: International Conference on Environmental Sensing and Assessment, Vol. 1, September 14-19, 1975, Las Vegas, Nevada, p 15-4-1 - 15-4-4. 4 fig, 1 tab, 6 ref.

A computerized gas chromatographic/mass spectrometric technique is proposed for use in a national monitoring system for identifying organics in natural water and industrial effluents. The system combines the separation capability of gas chromatography with the detection capability of mass spectrometry. A combination of the techniques results in a mass spectrum of each peak as it elutes from the gas chromatograph, thus providing a 'fingerprint' of the organic compounds in a sample. Computerization can be used to shorten the time required for spectral interpretation and compound identification. Other refinements include record-keeping programs to provde statistics on how frequently a given compound is identified, where particular compounds are identified, and how often the same unidentified spectrum is encountered. Currently, a data base of over 35,000 reference spectra exists.

*Organic compounds, *Gas chromatography, *Mass spectrometry, *Computers, *Pollutant identification, *Water quality, Industrial wastes, Effluents, Data collections, Data storage and retrieval, Monitoring, Analytical techniques

Natural waters

E085

CAPABILITIES AND LIMITATIONS IN IDENTIFYING AND MEASURING AQUATIC POLLUTANTS,

Donaldson, W. T.

U.S. Environmental Protection Agency,
Athens, Georgia,
Environmental Research Laboratory.

In: International Conference on Environmental Sensing and Assessment, Vol. 1, September 14-19, 1975, Las Vegas, Nevada, p 15-5-1 - 15-5-3. 13 ref.

Methods for the qualitative organic analysis and multi-element analysis of water samples, particularly drinking water, are discussed in terms of their present capabilities and limitations. Gas chromatography-mass spectrometry with computerized data interpretation allows for the identification of extractable, volatile organic compounds; but identification of polar and high molecular weight compounds is not possible by this method. Freeze concentration, low-temperature distillation, and high-pressure ion exchange liquid chromatography show some promise for the identification of polar compounds. Atmospheric pressure ionization mass spectrometry, Fourier transform infrared spectroscopy, Raman spectroscopy, and nuclear magnetic resonance spectrometry offer some hope for identifying high molecular weight compounds. For multi-element analyses, spark source mass spectrometry is capable of measuring simultaneously up to 82 elements at concentrations as low as one microgram/liter; however, this method is slow and expensive and requires a highly skilled analyst to operate the instrument. X-ray fluorescence and inductively coupled plasma emission spectrometry show promise for overcoming most of these shortcomings.

*Pollutant identification, *Potable water, *Organic compounds, *Gas chromatography, *Mass spectrometry, *X-ray fluorescence, *Nuclear magnetic resonance, Analytical techniques, Infrared radiation, Evaluation

Fourier transform infrared spectroscopy, Raman spectroscopy, Multi-element analysis, Freeze concentration, Low-temperature distillation, Ion exchange liquid chromatography, Plasma emission spectrometry

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E086

MONITORING ESTUARINE CIRCULATION AND OCEAN WASTE DISPERSION USING AN INTEGRATED SATELLITE-AIRCRAFT-DROGUE APPROACH,

Klemas, V., Davis, G., Wang, H., Whelan, W., and
Tornatore, G.

IIT Electro-Physics Laboratories, Incorporated,
Columbia, Maryland.

In: International Conference on Environmental Sensing and Assessment, Vol. 1, September 14-19, 1975, Las Vegas, Nevada, p 16-2-1 - 16-2-10. 14 fig, 1 tab, 11 ref.

An integrated satellite-aircraft-drogue approach for monitoring ocean waste dispersion and estuarine circulation is described. The approach employs remotely tracked expendable drogues together with satellite and aircraft observations of waste plumes and tracers such as suspended sediment or dye. The use of drogues tracking currents at various selected depths complements satellite imaging which is unable to determine current magnitude and to penetrate beyond the upper few meters of the water column. Since in turbid coastal regions suspended sediment acts as a natural tracer, cost is minimized by eliminating the need for expensive injections of large volumes of dye. Tests conducted on the Continental Shelf and in Delaware Bay indicate that the system can provide an effective means of studying current circulation, oil slick movement, and ocean waste dispersion even under severe environmental conditions. By combining the wide coverage of a satellite with aircraft or shore stations capable of tracking expendable drogues, a cost-effective, integrated monitoring system is achieved.

*Monitoring, *Dispersion, *Wastes, *Circulation, *Tracking techniques, *Tracers, *Remote sensing, Oceans, Estuaries, Sediments, Currents (water), Satellites (artificial), Aircraft, Oil spills

Drogues

E087

EVALUATION OF WATER SAMPLES COLLECTED DURING LANDSAT-1
OVERPASSES OF THE LOWER CHESAPEAKE BAY AREA,

Bowker, D. E., and Witte, W. G.

National Aeronautics and Space Administration,
Hampton, Virginia,
Langley Research Center.

In: International Conference on Environmental Sensing and Assessment, Vol. 1, September 14-19, 1975, Las Vegas, Nevada, p 16-3-1 - 16-3-5. 8 fig, 8 tab, 1 ref.

Water samples which were collected on 18 days when the LANDSAT-1 satellite was passing over the lower Chesapeake Bay area were analyzed and compared with MSS radiance values obtained from the satellite. An analysis of the radiance values revealed a low correlation with chlorophyll content and a good correlation with total particulates and sediment. The most consistent correlations were established with sediment; hence, this variable appears to be the most important water parameter for remote sensing surveys with the satellite. A linear relationship was established between sediment and particulates, but the relation varied widely from day to day. Thus, it was not possible to infer the sediment level from the total particle count without a calibration curve.

*Remote sensing, *Satellites, *Chesapeake bay, *Sediments, *Chlorophyll, Monitoring, Statistical methods, Sampling, Water quality

LANDSAT

E088

DETERMINATION OF SURFACE EQUILIBRIA AND MASS TRANSFER RATES
IN A CONCURRENT FLOW BUBBLE COLUMN,

Valdes-Krieg, E., King, C. J., and Sephton, H. H.

California University,
Berkeley,
Department of Chemical Engineering and
Sea Water Conversion Laboratory.

American Institute of Chemical Engineers Symposium Series, Vol. 71, No. 150, p 46-51, 1975. 4 fig, 21 ref.

A technique for the measurement of surface equilibria in a concurrent-flow, gas-liquid bubble column was developed as part of a more extensive program dealing with the removal of surfactants, metal ions, and particulate matter from aqueous systems by combined foam and bubble fractionation. Test solutions consisted of either de-ionized water or model solutions simulating three-fold concentrated seawater brine. The concurrent flow method allowed for the determination of surface equilibria under both foaming and nonfoaming conditions. Mass transfer coefficients computed from concurrent flow experiments indicate that care must be exercised in the design of devices for adsorption equilibrium measurements to ensure enough bubble contact time with the liquid for equilibration to occur. The mass transfer rates observed in the present experiment indicated that a satisfactory approach to equilibrium was obtained for a column of 174 cm in height.

*Foam fractionation, *Waste water treatment, *Adsorption, *Surfactants, *Metals, *Solid wastes, Separation techniques, Flow, Equilibrium, Brines, Ions, Treatment, Equipment, Evaluation

Bubble fractionation

E089

CHARACTERIZATION OF SULFIDE MINERAL SURFACES IN FROTH FLOTATION SYSTEMS USING ELECTRON SPECTROSCOPY FOR CHEMICAL ANALYSIS,

Clifford, R. K., Purdy, K. L., and Miller, J. D.

Missouri-Rolla University,
Rolla,
Department of Metallurgical and
Nuclear Engineering.

American Institute of Chemical Engineers Symposium Series, Vol. 71, No. 150, p 138-147, 1975. 6 fig, 4 tab, 44 ref.

The feasibility of using electron spectroscopy for the characterization of 10 natural sulfide mineral surfaces in froth flotation systems was evaluated. Surface analyses on high quality specimens were made after comminution in air, comminution in a nitrogen atmosphere, adsorption of xanthate collector, and adsorption of dithiophosphate collector. Analyses were also made after modifiers such as disodium chromate, sulfur dioxide, starch, sodium cyanide, and copper sulfate and the collector had been adsorbed onto the surfaces of the sulfide minerals. Electron spectroscopy proved to be useful for following the action of modifiers rather than collectors due to the large amounts of sulfur and background carbon already present on the sulfide surfaces. The technique shows potential for yielding semiquantitative chemical analyses of the oxidation states of many elements on mineral surfaces. Normalization constants for semiquantitative analyses based on relative elemental sensitivity were calculated for each of the ten minerals studied.

*Analytical techniques, *Spectroscopy, *Froth flotation, *Waste treatment, *Sulfides, *Adsorption, Measurement, Feasibility studies, Evaluation, Surfaces

Electron spectroscopy

E090

WATER TRANSPORT ACROSS CATION-EXCHANGE MEMBRANE. I. EXPERIMENTAL TECHNIQUE. INFLUENCE OF THE CONCENTRATION AND TEMPERATURE ON THE WATER TRANSPORT NUMBER,

Demarty, M., Maurel, A., and Selegny, E.

Faculty of Science and Technique at Rouen,
Rouen, France,
Laboratory of Macromolecular Chemistry.

March, 1975. 24 p, 5 fig, 10 tab, 24 ref. Technical Translation F-16,169.
Translated from Journal de Chimie Physique, Vol. 71, No. 6, p 811-818, 1974.

An automatic method for measuring electro-osmotic flows was developed, derived from the capillary technique. A photoelectric system is used to observe the change of position of the meniscus in the capillary, and an electric voltage proportional to it is provided. Extremely small flows can be measured because the movements of the fluids can be amplified about 100-fold. The method was used to measure the water transport numbers of two cation-exchange membranes while varying the concentration of the solutions, the nature of the electrolytes, and the temperature. Current density did not influence the electro-osmotic flows when the solutions flooding the surface were sufficiently agitated. The water transport number increased at low current densities when there was no agitation. There was a strong dependence between water transport number and concentration between 0.01 and one N. The nature of the ion is important; smaller ions have a weaker effect. Increasing the concentration causes a considerable penetration of salt inside the membrane, which diminishes the effective charge of the membrane. The membrane also deflates, decreasing the hydraulic permeability. Measured water transport numbers were compared with those calculated with Manning's model for sodium chloride at different concentrations. A satisfactory semiquantitative agreement between the experimental and calculated values was obtained. However, the model cannot explain the polarization effects observed while measuring the water transport number as a function of current density under natural convection.

E091

SOME PRACTICAL PROBLEMS IN DEVELOPING AND PRESENTING ENVIRONMENTAL QUALITY INDICES TO THE PUBLIC,

Coate, L. E., and Mason, A. K.

Environmental Protection Agency,
Seattle, Washington,
Region X.

In: International Conference on Environmental Sensing and Assessment, Vol. 2, September 14-19, 1975, Las Vegas, Nevada, p 31-2-1 - 31-2-4. 1 tab.

The rationale for selecting specific environmental quality indices is presented along with an example of the establishment of a regional water quality index. Guidelines for the adoption of indices include: their ability to be understood by the public, their ability to relate to standards or legislative goals as well as to health and lifestyle; their flexibility for updating, and their usefulness for assisting in program management and resource allocation. An example of the application of these guidelines is presented in the form of a water quality index which is based on the percentage of the river or river miles meeting water quality standards. The index involves the utilization of 10 pollution categories: dissolved oxygen, temperature, pH, aesthetics, total dissolved gases, total dissolved solids, radioactivity, pathogens, organic toxicants, and inorganic toxicants. The criterion used for determining whether a violation exists is the state-established health standard for that particular river at a given location.

*Indicators, *Data processing, *Water quality, *Evaluation, Rivers, Regional analysis, Water pollution effects, Measurement, Monitoring

Environmental indices

E092

ENVIRONMENTAL INDICES AND MONITORING,

Inhaber, H.

Environment Canada,
Ottawa, Canada,
Science Policy Branch.

In: International Conference on Environmental Sensing and Assessment, Vol. 2, September 14-19, 1975, Las Vegas, Nevada, p 31-1-1 - 31-1-3. 6 ref.

The usefulness of environmental indices is discussed along with their relationship to monitoring. Environmental indices compare the actual state of part of the environment to a desirable standard. Since indices are only as good as the data on which they are based, their usefulness depends on adequate and accurate monitoring facilities. The use of environmental indices can indirectly diminish problems associated with over-lapping monitoring policies and networks since they provide a goal for monitoring activities. Indices also tend to speed up the processing and reporting of environmental data since their purpose is to inform the public on the state of the environment. Since environmental indices tend to regularize the collection of data, problems associated with assessing the synergistic effects of pollutants are diminished by the use of indices.

*Monitoring, *Data collections, *Data processing, *Indicators, Measurement, Evaluation, Analytical techniques

Environmental indices

E093

MONITORING FOR ORGANIC POLLUTANTS IN GREAT BRITAIN,

Verdin, A.

Analysis Automation Limited,
Oxford, England.

In: International Conference on Environmental Sensing and Assessment, Vol. 2, September 14-19, 1975, Las Vegas, Nevada, p 30-3-1 - 30-3-3. 5 fig, 19 ref.

Water and air pollution monitoring activities in Great Britain are reviewed. Although the basic parameter in British water treatment is the 5-day biochemical oxygen demand value which is not amenable to adaption for continuous monitoring, a number of commercial systems for chemical oxygen demand and other measurements are being used for effluent monitoring. A simple on-line device which uses the correlation between total organic carbon or biochemical oxygen demand and ultraviolet absorption at 254 nanometers has also been developed. An oil-in-water monitor which uses the single beam ultraviolet absorption principle and a sophisticated sample conditioning system is being used at a North Sea oil facility. Extensive multiparameter water quality networks are being developed in Britain, although they do not include any organics monitors yet. Individual organics are analyzed in grab samples by gas chromatography and mass spectrometry.

*Monitoring, *Water quality, *Effluents, *Organic compounds, *Analytical techniques, Instrumentation, Equipment, Measurement, Biochemical oxygen demand, Chemical oxygen demand, Carbon, Gas chromatography, Mass spectrometry, Ultraviolet radiation, Oil

Great Britain

E094

FLUORESCENCE MEASUREMENTS OF CARCINOGENIC AND POLYCYCLIC AROMATIC HYDROCARBONS IN WATER,

Schwartz, F. P., and Wasik, S. P.

National Bureau of Standards,
Washington, D. C.,
Institute for Materials Research.

In: International Conference on Environmental Sensing and Assessment, Vol. 2, September 14-19, 1975, Las Vegas, Nevada, p 30-2-1 - 30-2-5. 5 fig, 10 ref.

The feasibility of using fluorescence spectrometry for determining carcinogenic and polycyclic aromatic hydrocarbons in water was investigated. At naperian absorbances of less than or equal to 0.05, the fluorescence intensities of solutions containing naphthalene, anthracene, pyrene, and fluoranthene in water were a superposition of the component fluorescence spectra. The fluorescence spectra varied unpredictably with concentration when viewed perpendicular to the excitation light and at higher polynuclear aromatic optical densities in the mg/liter range. Polynuclear aromatic fluorescence intensity was not affected by the presence of sodium chloride at sea water concentrations or by the presence of mg/liter concentrations of iron, zinc, cobalt, or nickel cations in water.

*Fluorescence, *Spectrophotometry, *Pollutant identification, *Aromatic compounds, Analytical techniques, Feasibility studies, Evaluation, Sea water

Polynuclear aromatic hydrocarbons, Carcinogens, Naphthalene, Anthracene, Pyrene, Fluoranthene

E095

ANALYSIS OF ORGANIC POLLUTANTS IN DRINKING WATER,

Suffet, I. H., and Radziul, J. V.

Drexel University,
Philadelphia, Pennsylvania,
Department of Chemistry.

In: International Conference on Environmental Sensing and Assessment, Vol. 2, September 14-19, 1975, Las Vegas, Nevada, p 30-1-1 - 30-1-7. 5 fig, 4 tab, 23 ref.

Isolation techniques and analytical methods for the determination of organic compounds in drinking water are discussed. Isolation techniques covered include: liquid-vapor phase isolation in the form of head gas analysis, liquid-liquid phase isolation in the form of solvent extraction, liquid-solid phase isolation in the form of carbon adsorption, and absorption by macroreticular resins. Analytical approaches are discussed in terms of quantitative and general screening methods. The development of quantitative analysis techniques for bis(2-chloroethyl)ether and chloroform are described along with the use of gas chromatography/mass spectrometry for the identification of organic compounds in Philadelphia drinking water. A list of 20 organic compounds found in the drinking water is presented and reveals the presence of 1,1,1-trichloroacetone, a precursor of chloroform. A constant background of hydrocarbon substituted benzene and chlorinated alkanes is also observed for the drinking water sample.

*Analytical techniques, *Separation techniques, *Pollutant identification, *Potable water, *Organic compounds, Gas chromatography, Mass spectrometry, Ethers

Chlorinated hydrocarbons, Aromatic hydrocarbons, Chloroform, Trichloroacetone, Acetones, Chlorinated alkanes, Precursor compounds, Bis(2-chloroethyl)ether, Benzenes

E096

THE ENVIRONMENTAL INFORMATION SYSTEM (EIS) IN SWEDEN AND MONITORING OF THE ENVIRONMENT,

Palmlund, I., and Andersson, I.

Swedish Council of Environmental Information,
Stockholm, Sweden,
Jordbruksdepartementet.

In: International Conference on Environmental Sensing and Assessment, Vol. 2, September 14-19, 1975, Las Vegas, Nevada, p 25-2-1 - 25-2-3. 1 fig, 1 tab.

The structure of the Swedish Environmental Information System is outlined. The system is designed to provide coordinated and standardized data collection concerning air, water, and ground quality in both polluted and unpolluted areas. Information concerning products and chemical substances subject to control, major polluting sources, and research and data collection activities throughout the country is also provided by the system. The development of the Environmental Information System is now in progress under the direction of the Swedish Council of Environmental Information which is also planning a study of the coordinated utilization of the Environmental Information System and meteorological, hydrological, and other data bases.

*Data collections, *Data processing, *Information retrieval, *Monitoring, Programs, Measurement, Pollutant identification, Methodology

Sweden, Environmental Information System

E097

THE MEANING AND MEASUREMENT OF TURBIDITY,

Pijanowski, B. S.

National Oceanic and Atmospheric Administration,
Rockville, Maryland,
National Oceanographic Instrumentation Center.

In: International Conference on Environmental Sensing and Assessment, Vol. 2, September 14-19, 1975, Las Vegas, Nevada, p 21-6-1 - 21-6-5. 6 fig, 13 ref.

Problems associated with the use of turbidity as an optical indicator of water quality are discussed along with recommendations of a workshop on turbidity sponsored by the National Oceanographic Instrumentation Center. The term turbidity is recommended for use only as a qualitative descriptor and not as a parameter for measurement. The concept of turbidity is optical and in a broad sense is an indication of suspended particulate matter. A single optical measurement cannot be used to measure suspended particulates in general because the optical characteristics of the particulates are complex functions of particle size and shape, absorption, and other parameters. It is recommended that when optical measurements are made they be identified with the type of instrument used and that the instruments not be calibrated in artificial units as is the common practice currently. Conceptual descriptions of the following types of turbidity measuring instrumentation are provided: the Jackson Candle turbidimeter, transmissometers, nephelometers, and ambient light meters. Accepted methods for turbidity measurements and instrument calibration are also outlined.

*Analytical techniques, *Turbidity, *Water quality, *Optical properties, *Suspended solids, Physical properties, Measurement, Instrumentation, Equipment, Calibrations

Transmissometers, Nephelometers, Ambient light meters, Jackson candle turbidimeter

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E098

PROBLEMS IN ANALYSES OF ORGANIC POLLUTANTS IN OPEN-OCEAN SAMPLES,

Giam, C. S., Chan, H. S., and Neff, G. S.

Texas A and M University,
College Station,
Department of Chemistry.

In: International Conference on Environmental Sensing and Assessment, Vol. 2, September 14-19, 1975, Las Vegas, Nevada, p 21-1-1 - 21-1-3. 3 tab, 3 ref.

Techniques for avoiding the contamination of open-ocean samples during collection and analysis for organic pollutants are discussed. General precautions against contamination include: concentrating an aliquot of each bottle of reagent used in the procedure; the removal of organics from laboratory tap water by liquid-liquid extraction; the cleaning of solid reagents by heating; the purification of gases used to evaporate solvents by passage through a molecular sieve or other suitable trap; the use of equipment made from glass, teflon, or metal; the avoidance of materials made from plastics, rubber, and cork; the use of a minimum amount of equipment; and the performance of frequent procedure blanks. Selected results of analyses performed on samples from the Gulf of Mexico are presented for DDT, polychlorinated biphenyl, and phthalate ester plastizers to illustrate the efficacy of such precautions.

*Pollutant identification, *Organic compounds, *Analytical techniques, *Sampling, *Equipment, *Quality control, *Sea water, DDT, Polychlorinated biphenyls, Chlorinated hydrocarbon pesticides

Phthalate ester plastizers, Sample collection, Laboratory reagents

E099

DESIGN OF POLLUTANT ORIENTED INTEGRATED MONITORING SYSTEMS,

Schuck, E. A., and Morgan, G. B.

In: International Conference on Environmental Sensing and Assessment, Vol. 2, September 14-19, 1975, Las Vegas, Nevada, p 20-6-1 - 20-6-6. 8 fig, 11 ref.

The use of an integrated monitoring systems approach for assessing the sources and environmental impact of specific pollutants is discussed. The integrated monitoring systems approach simultaneously takes into account the critical receptors, critical transport pathways, and critical sources. The use of the integrated monitoring systems approach for illustrating the flow of lead from sources through various environmental pathways and its interaction with a critical receptor (an urban child under 6 years of age) revealed that lead from drinking water sources represents a minor contribution to exposure, except in small isolated areas, since most of the particulate lead in the environment is largely in an insoluble form. A flow diagram of the fate of lead contributed from an automotive fleet reveals that street runoff into coastal waters accounts for only about 2% of the total lead emitted. The application of the integrated concept to the test case demonstrated the inability of conventional chemical and physical methods for monitoring total exposure of a critical receptor.

*Monitoring, *Systems analysis, *Water pollution effects, *Lead, *Flow, *Water pollution sources, Path of pollutants, Runoff, Analytical techniques, Evaluation

E100

X-RAY DIFFRACTION AND ELECTRON BEAM ANALYSIS OF ASBESTIFORM MINERALS IN LAKE SUPERIOR WATERS,

Cook, P. M., Rubin, I. B., Maggiore, C. J., and Nicholson, W. J.

In: International Conference on Environmental Sensing and Assessment, Vol. 2, September 14-19, 1975, Las Vegas, Nevada, p 34-1-1 - 34-1-9. 7 fig, 2 tab, 12 ref.

Electron microscopic and X-ray diffraction analyses of asbestiform amphibole fibers in Lake Superior water are reported. The lake, which is used for municipal water supplies, contains large concentrations of asbestiform minerals as a result of a taconite tailings discharge at Silver Bay, Minnesota. Daily X-ray diffraction studies and occasional transmission electron microscope measurements of Duluth, Minnesota drinking water samples revealed amphibole fiber counts per liter of water ranging from 10-1000 million, with the average being 45-100 million. Not all of the amphibole fibers present can be identified due to their extremely small width. Large fluctuations in fiber concentrations are attributable to seasonal and meteorological changes which influence Western Lake Superior water circulation. Variations in electron microscope amphibole fiber counts generally correspond to variations in amphibole mass concentration determined by X-ray diffraction.

*Asbestos, *Lake Superior, *Electron microscopy, *Potable water, *X-ray diffraction, Pollutant identification, Industrial wastes, Mineral industry, Solid wastes, Analytical techniques, Lakes

Asbestiform amphibole fibers, Taconite tailings

E101
TOWARDS A COMPUTER-BASED INFORMATION MONITORING SYSTEM
FOR GROUNDWATER DATA IN NEW ZEALAND,

McCammon, R. B.

Illinois University,
Chicago,
Department of Geological Sciences.

In: International Conference on Environmental Sensing and Assessment, Vol. 2, September 14-19, 1975, Las Vegas, Nevada, p 31-6-1 - 31-6-5. 2 fig, 4 ref.

The development of a computer-based information retrieval system for groundwater data in New Zealand is discussed. Currently there are over 20,000 water well records on file in New Zealand dealing with information obtained from drilling, subsequent test pumping, and water quality analyses. Thus, the need exists for developing a computerized storage and retrieval system. Three types of computer dialogues are currently being considered: question-and-answer types, menu-selection types, and natural-English dialogues. The importance of involving potential users in the development of the groundwater information system is stressed.

*Data storage and retrieval, *Computer programs, *Data collections, *Groundwater, *Water quality, Data processing, Wells, Water sampling, Monitoring

New Zealand

E102
SAMPLE TRACKING DATA MANAGEMENT SYSTEM,

Snelling, R. N., Madsen, M. J., and Allison, G. C.

Environmental Monitoring and Support Laboratory,
Las Vegas, Nevada.

In: International Conference on Environmental Sensing and Assessment, Vol. 2, September 14-19, 1975, Las Vegas, Nevada, p 31-3-1 - 31-3-4. 3 fig, 1 tab.

A system for tracking laboratory samples of water or other materials through their respective analyses to completion is described. The system, which is known as the Sample Tracking Data Management System, provides for the storage and retrieval of data from a direct access master file. On the input side, sample identification and collection data are entered through the use of a sample header information card and a location description information card. The system allows for the interfacing of laboratory analytical programs directly with the master file for the purpose of retrieving needed sample collection information. Analytical result cards are generated for direct reentry into the data management system. On the output side of the system, data summaries may be generated directly from the master file. Working files may also be created for utilizing special purpose application programs such as dose models, plotting, contouring, and statistical analysis. The sample tracking module of the system provides a tool to management for evaluating and controlling the laboratory operations function by providing sample status information.

*Quality control, *Computer programs, *Data collections, *Tracking techniques, Analytical techniques, Data processing, Data storage and retrieval

E103

DETERMINATION OF NITRATE ION AT THE PART PER BILLION LEVEL IN ENVIRONMENTAL SAMPLES WITH A CONTINUOUS FLOW IMMOBILIZED ENZYME REACTION,

Senn, D. R., Carr, P. W., and Klatt, L. N.

Georgia University,
Athens,
Department of Chemistry.

Analytical Chemistry, Vol. 48, No. 7, p 954-958, June, 1976. 4 fig, 4 tab, 29 ref.

An enzymatic procedure for the colorimetric determination of nitrate ion in aqueous samples is described. The method is based on the enzymatic reduction of nitrate to nitrite by the radical cation of 1,1'-dimethyl-4,4'-bipyridinium dichloride in the presence of the enzyme nitrate reductase. The production of nitrite is monitored by the sulfanilamide N-(1-naphthyl)ethylenediamine dichloride azo dye reaction. A detection limit of 17 ppb is possible using a 1-centimeter cell in a continuous flow analyzer. The detection limit can be increased to about 2 ppb by using a non-flow system since photometer noise is the major limiting factor. Although the procedure utilizes an immobilized enzyme, the method can be adapted for use with soluble enzyme preparations. Analyses of industrial effluent samples revealed good correlation with the accepted copper-cadmium reductor method. The precision of the method is 1% in a continuous flow analyzer for a concentration of 0.2 ppm. The method can also be used for analyzing sea water samples where the nitrate content is typically less than 50 ppb.

*Colorimetry, *Enzymes, *Nitrates, *Pollutant identification, Analytical techniques, Industrial wastes, Sea water, Effluents, Ions

E104

MOST PROBABLE NUMBER VERSUS MEMBRANE FILTER ON CHLORINATED EFFLUENTS,

Mowat, A.

Rockland County Sewage Treatment Plant,
Orangeburg, New York.

Journal Water Pollution Control Federation, Vol. 48, No. 4, p 724-728, April, 1976. 3 tab, 4 ref.

A total of 25 experiments were conducted at a sewage treatment plant using the activated sludge process to compare the results obtained by the most probable number and membrane filter techniques for total coliform determination on chlorinated and unchlorinated secondary effluent. Great discrepancies between the two methods were observed for unchlorinated effluent, whereas good correspondence between the two techniques was obtained for chlorinated secondary effluent, especially at bacterial densities below 1000. Samples with 30-minute chlorination times yielded better agreement between the two techniques than did samples with only 15-minute chlorination times. This may indicate that the longer chlorination time effected a good kill of the bacteria, while the shorter chlorination time was only partially effective, allowing recovery of the bacteria under favorable conditions. The discrepancy between the two methods for unchlorinated samples remains unexplained.

*Coliforms, *Analytical techniques, *Sewage treatment, *Treatment facilities, *Chlorination, *Quality control, Statistics, Evaluation, Microorganisms, Bacteria, Waste treatment, Effluents, Measurement, Membrane processes, Pollutant identification

Most probable number technique

316

E105

THE USE OF CARBON DIOXIDE IN SAMPLING AND PRESERVING NATURAL LEACHATES,

Korte, N. E., Niebla, E. E., and Fuller, W. H.

Arizona University,
Tucson,
Department of Soils, Water and Engineering.

Journal Water Pollution Control Federation, Vol. 48, No. 5, p 959-961, May, 1976. 2 fig, 2 tab, 9 ref.

The use of carbon dioxide for preserving natural leachate samples collected for the purpose of assessing the pollution potential of sanitary landfills was investigated. Two sets of natural leachate obtained from a commercial septic tank were collected, one under carbon dioxide and the other exposed to the atmosphere. For the collection and maintanance of samples under carbon dioxide, the collection vessel was first purged with the gas, and the leachate was added while the effluent was being flushed with carbon dioxide. Leachate collected with carbon dioxide did not show precipitation or changes in pH, color, and dissolved inorganic ion concentration which were associated with leachate samples exposed to the atmosphere. Such changes occurred even as a result of momentary contact of the sample with air, indicating the degree of precaution required to preserve neutral natural leachates.

*Leachate, *Sampling, *Preservation, *Carbon dioxide, *Chemical properties, Landfills, Pollutant identification, Inorganic compounds, Ions, Chemical reactions

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E106

MICROMETHODS FOR THE DETERMINATION OF NONFILTERABLE AND FILTERABLE RESIDUES,

Carter, M. J., Huston, M., and Logsdon II, O. J.

Environmental Protection Agency,
Chicago, Illinois,
Central Regional Laboratory.

Journal Water Pollution Control Federation, Vol. 48, No. 4, p 652-659, April, 1976. 5 tab, 23 ref.

Micromethods for the gravimetric analysis of nonfilterable and filterable residues in water samples are described and compared with standard methods. An electronic microbalance equipped with digital display units and a polonium-210 ionizing source to reduce the electrostatic charge on the filters is used for both nonfilterable and filterable determinations. Sample filtration is performed with a Millipore thirty-place membrane sampling manifold using 15- by 125 millimeter culture tubes to receive the filtrate. A comparison of the micromethod for both nonfilterable and filterable residue analysis with the corresponding standard methods reveals no significant differences for a variety of water sample types. The precision of the micromethod for nonfilterable residue analysis is 3 mg/liter below 50-mg/liter nonfilterable residue and 9 mg/liter above 50 mg/liter at the 95% confidence level. The precision of the method for filterable residue analysis is 26 mg/liter at the 95% confidence level.

*Gravimetric analysis, *Pollutant identification, *Analytical techniques, Evaluation, Filters, Equipment, Measurement, Filtration, Membrane processes

Filterable residues

E107

IDENTIFICATION OF ORGANIC COMPOUNDS IN EFFLUENTS FROM INDUSTRIAL SOURCES,

Abrams, E. F., Derkics, D., Fong, C. V., Guinan, D. K., and Slimak, K. M.

Versar, Incorporated,
Springfield, Virginia,
General Technologies Division.

April, 1975. 172 p, 2 fig, 11 tab, 208 ref, 4 append. Technical Report PB-241 641.

An initial assessment is provided of the possible sources of 154 organic compounds which have been identified in drinking water supplies. Of these, 113 are classified as major pollutants. The most obvious industrial source of organics is the point source discharge of effluents, both treated and untreated. Chlorinating such effluents controls biochemical oxygen demand (BOD) but can create highly unreactive substances. In municipal systems, discharged compounds may become halogenated, be partially or completely degraded, or remain unchanged. Organics emitted as air pollutants may enter surface waters by rainfall. Organic compounds from landfilled solid wastes, sludges, and slurries may leach into groundwater where they may be degraded or interact to produce other organic compounds. Discharges from domestic treatment plants may also be responsible for a variety of chlorinated organics. Chlorination of river water containing organics can produce several halomethanes and haloethanes. Industrial product use, however, appears to be the greatest potential source of organic pollutants, because recovery of product is maximized during manufacture. Sixty-seven of the compounds considered may be formed by various chemical reactions in air, water, or soil. Of the 154 compounds studied, 7 were classified as easily degraded, 17 as degraded without much difficulty, 41 as difficult to degrade, 36 as very difficult to degrade, and 53 as refractory. This distribution is as expected, because less persistant chemicals should be expected to degrade closer to their sources before being detected.

*Waste water treatment, *Pollutant identification, *Biochemical oxygen demand, *Organic compounds, *Water supply, Chemical wastes, Chemical industry, Chemistry

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E108

EVALUATION OF TOXICITIES AND ENVIRONMENTAL IMPACT IN 'SYMBIOTIC' WATER REUSE SYSTEMS,

Kraus, M. P.

In: 3rd National Conference on Complete WateReuse, June 27-30, 1976, Cincinnati, Ohio, p 476-482. 6 tab, 4 ref.

Viral assay data for various symbiotic water reuse systems are reviewed. Assays of water samples from a variety of oxidation lagoons revealed great variations in virus counts, with zero counts almost never being observed. Studies of soil treatment of dairy barn wastes showed appreciable virus removals, though the condition of the removed viruses was not determined. Considerable alteration in virus population was observed as a result of spray irrigation of domestic sewage onto woodland, with host-range, plaque-morphology patterns being significantly different than those of sewage samples. Viruses were found to abound in sludge disposed of on land, including digested or heat-treated sludge. The use of ionizing radiation for destroying viruses in sludges, treated sewage, and lagooned wastes suitable for use in certain chemical processes was also investigated, and it appears possible to regulate doses so that satisfactory treatment can be provided in some cases. However, certain strains of bluegreen algae carrying latent viruses have not proved inducible and remain very resistant to large doses of radiation.

*Viruses, *Toxicity, *Waste water treatment, *Water reuse, *Reclaimed water, *Bioassay, Sewage, Sludge, Irrigation, Oxidation lagoons, Sludge disposal, Sludge treatment, Radiation, Waste treatment, Pollutant identification, Algae

E109
AN EVALUATION OF THE APPLICABILITY OF PYROLYSIS-GAS-LIQUID CHROMATOGRAPHY FOR THE IDENTIFICATION OF MICROORGANISMS IN WATER AND SEWAGE TREATMENT PLANT EFFLUENTS,

Symuleski, R. A.

National Bureau of Standards,
Washington, D. C.,
Center for Building Technology.

In: 3rd National Conference on Complete WateReuse, June 27-30, 1976, Cincinnati, Ohio, p 457-461. 2 fig, 1 tab, 29 ref.

A study of pyrolysis-gas-liquid chromatography was performed to determine its feasibility for the automated identification of bacteria in water and waste water treatment effluents. Analysis of chromatograms and integrator tapes from ten runs on Escherichia coli showed a very high degree of reproducibility, even between samples with weight differences of between 300 and 400 micrograms. The maximum standard deviation in retention time for any one peak occurring early in the trace was plus or minus 0.07 minutes. The highest degree of reproducibility in retention times occurred after peak 16, with the maximum standard deviation being plus or minus 0.04 minutes. The technique appears to have good potential for routine taxonomic work, and the present study indicates that the detection of E. coli can be made at levels that are occasionally encountered in sewage treatment plant effluents. Further work is necessary to determine whether or not the technique is applicable for the analysis of bacteria at concentrations as low as 2-10 colonies/100 ml.

*Pollutant identification, *Bacteria, *Waste water, *E. coli, *Chromatography, *Automation, Effluents, Analytical techniques, Coliforms, Microorganisms, Feasibility studies, Evaluation

Pyrolysis-gas-liquid chromatography

E110
WATER-POLLUTION INSTRUMENTATION,

Thompson, R. G.

Roy F. Weston, Incorporated,
West Chester, Pennsylvania.

Chemical Engineering, Vol. 83, No. 13, p 151-154, June 21, 1976. 3 fig, 1 tab, 5 ref.

Brief descriptions of water pollution control instrumentation and monitoring techniques are presented. Waste water treatment equipment discussed includes: neutralization sections, primary clarifiers, aeration basins, thickeners, digesters, dewatering devices, incinerators, filters, and chlorination systems. Monitoring techniques covered include: flow monitoring, pH monitoring, temperature monitoring, turbidity measurements, conductivity measurements, residual chlorine monitoring, dissolved oxygen monitoring, total organic carbon monitoring, and biochemical oxygen demand measurements. Composite sampling is also discussed.

*Waste water treatment, *Treatment facilities, *Instrumentation, *Equipment, *Monitoring, Measurement, Dissolved oxygen, Carbon, Organic compounds, Biochemical oxygen demand, Turbidity, Sampling, Chlorine, Chlorination, Aeration, Incineration, Dewatering, Filters, Digestion tanks, Temperature, Conductivity, Neutralization

E111
CONCENTRATIONS OF NITRIFYING BACTERIA IN SEWAGES, EFFLUENTS, AND A RECEIVING STREAM AND RESISTANCE OF THESE ORGANISMS TO CHLORINATION,

Strom, P. F., Matulewich, V. A., and Finstein, M. S.

Rutgers-New Jersey State University,
New Brunswick,
Department of Environmental Science.

Applied and Environmental Microbiology, Vol. 31, No. 5, p 731-737, May, 1976.
2 fig, 2 tab, 27 ref.

Estimates of nitrifying bacteria (NH4(+) and NO2(-) oxidizers) in samples from four activated sludge plants treating mainly domestic sewage were obtained using a most probable number technique. Concentration ranges per milliliter were 1010-3880 and 79-145 in settled sewages, 32-7420 and 2-1010 in secondary effluents, and from less than 0.1 to 622 and 0.1-70 in chlorinated secondary effluents. These results indicated that nitrifiers are more resistant to chlorination than fecal streptococci. Laboratory studies with these nitrifying bacteria involving chlorine exposures of up to 2 milligrams/liter for 0-60 minutes also indicated that nitrifiers are more resistant than fecal streptococci to chlorination, with the NO2(-) oxidizers showing the greatest resistance. Below the outfall of a sewage plant that discharges heavily chlorinated unnitrified effluent, NH4(+) oxidizers amounted to approximately 20 million/gram of slime scraped from stream-bed rocks. The figure upstream of the outfall was about 300,000/gram.

*Microbiology, *Bacteria, *Waste water (pollution), *Waste water treatment, *Chlorination, Resistance, Effluents, Microorganisms, On-site investigations, Pollutant identification, Activated sludge, Sewage, Domestic wastes

Nitrifying bacteria, Most probable number technique

E112
REVIEW AND EVALUATION OF AVAILABLE TECHNIQUES FOR DETERMINING PERSISTENCE AND ROUTES OF DEGRADATION OF CHEMICAL SUBSTANCES IN THE ENVIRONMENT,

Howard, P. H., Saxena, J., Durkin, P. R., and Ou, L-T.

Syracuse University Research Corporation,
Syracuse, New York,
Life Sciences Division.

May, 1975. 549 p, 54 fig, 48 tab, 745 ref. Technical Report PB-243 825.

Techniques used to study the persistence and breakdown of chemicals in the environment are reviewed, based on information from papers, books, review articles, and abstracting and computer services. A cost analysis of the techniques was also undertaken. The quality and quantity of the information varied considerably; pesticides and detergents in water and sewage were intensively studied. A relationship between environmental persistence and chemical structure is presented, with some theoretical grounds for such correlations. An attempt was made to categorize chemicals by suitable test methods. Precise criteria for evaluating environmental stability are lacking. There are three types of degradation: biodegradation, photochemical degradation, and chemical degradation. In contrast to the others, biodegradation generally yields completely mineralized end products. Biochemical oxygen demand (BOD) is frequently used for rapid screening. The river die-away test monitors the disappearance of the test chemical in natural water. Shake culture tests can use either mixed or pure cultures. Semicontinuous and miniature continuous models of activated sludge systems and models of tricking filter and anaerobic systems can measure biodegradability in sewage treatment systems. Determining biodegradation routes requires several methods, often involving cell-free extracts. Photochemical processes except in the atmosphere are poorly understood. Chemical degradation of some compounds should be studied in sterilized media. Because laboratory biodegradability studies are qualitative, they are relatively less important for metal compounds, many of whose reactions are reversible.

E113
MICROBIOLOGY - DETECTION, OCCURRENCE, AND REMOVAL
OF VIRUSES,

Berg, G.

Environmental Protection Agency,
Cincinnati, Ohio,
Environmental Research Center.

Journal Water Pollution Control Federation, Vol. 48, No. 6, p 1410-1416,
June, 1976. 44 ref.

A literature review of papers dealing with the detection, occurrence, and removal of viruses from water is presented. General topics covered include: methods for recovering viruses from water, virus survival, water-related disease outbreaks, the removal of viruses by treatment processes, and indicators of viruses. Specific subjects discussed under the above general headings include: the effectiveness of adsorbent filters for recovering poliovirus 1 from large volumes of seeded finished drinking water, the inactivation of coliphage f2 viruses in waste water and drinking water at various temperatures, the recovery of an attenuated strain of poliovirus 3 from a finished water sample taken from a treatment plant, waterborne outbreaks of hepatitis, the use of coagulation with iron chloride and rapid sand filtration to remove poliovirus 1 in seeded synthetic water, and the usefulness of coliforms as indicators of viruses.

*Viruses, *Microbiology, *Waste water, *Potable water, *Pollutant identification, *Waste water treatment, Diseases, Epidemiology, Adsorption, Filters, Temperature, Coagulation, Filtration, Bioindicators, Coliforms

Hepatitis, Poliovirus, Coliphages

E114
STUDY ON THE EFFICIENCY OF FOUR PROCEDURES FOR ENUMERATING
COLIFORMS IN WATER,

Dutka, B. J., and Tobin, S. E.

Canada Centre for Inland Waters,
Burlington, Ontario, Canada,
Microbiology Laboratories.

Canadian Journal of Microbiology, Vol. 22, No. 5, p 630-635, 1976. 5 tab, 8 ref.

Four coliform estimation procedures were compared as to their ability to enumerate coliform bacteria from sewage, effluent, and various fresh waters in the lower Great Lakes Region of Canada. The procedures included a most probable number (MPN) technique using lauryl tryptose broth (LST) and brilliant green bile 2% broth (BGB), a membrane filtration (MF) technique using m Endo agar LES, an MPN technique using Parhad chemically defined synthetic medium (PCDS) and BGB developed for Indian fresh waters, and an MF(mC agar) technique developed for seawater. Within the survey area, maximum population estimates generally were achieved by the MF procedure using m Endo agar LES. The MPN procedure with the LST-BGB combination appears to provide the best estimates of raw sewage coliform densities. It estimates about double the population of its closest competitor, PCDS-BGB-MPN technique. Each procedure was selective for different genera of the Enterobacteriaceae.

*Pollutant identification, *Analytical techniques, *Sewerage, *Effluents, *Coliforms, Efficiencies, Estimating, Bacteria, Laboratory tests

Enumeration

E115

LABORATORY EVALUATION OF POLYMERIC FLOCCULANTS,

Benedek, A., and Bancsi, J. J.

McMaster University,
Hamilton, Canada,
Department of Chemical Engineering.

Journal of the Environmental Engineering Division-ASCE, Vol. 102, No. EE1, p 17-28, February, 1976. 10 fig, 18 ref, 1 append.

An adaptation of the method of multiple sampling during quiescent settling was used to study flocculation. A 35 cm high batch settling apparatus was used. It included a sampling tube 7.62 cm from the bottom surface and a stirring apparatus. Waste water with coagulant was mixed rapidly for 6 min, then slowly for 14 min. Any polymers used were added at 5 min. After the 20 min of mixing, the mixture was sampled automatically for 40 min as it settled. A Cahn Electro Balance was also used to determine the settling velocity distribution without sampling. An 8 ft high long tube settler was also used to simulate full-scale clarifiers where flocculation can take place during the entire downward passage of a floc. The modified jar test successfully yielded velocity size distributions. Settling in the batch settling apparatus is not affected by sampling errors. Phosphorus precipitate and other suspended solids enmesh in a chemical floc. Phosphorus and suspended solids concentrations are equally effective for monitoring settling. Comparison with results from the long tube settler indicates that the settling rates calculated from the batch settling apparatus tests tend to be conservative due to lack of allowance for flocculation during settling. At least 5 min of rapid mix between coagulant and polymer addition, 1 min rapid mix after polymer addition, and 4 min of slow mix for flocculation are recommended for chemical flocculation studies in the batch settling apparatus.

*Waste water treatment, *Analytical techniques, *Treatment facilities, *Laboratory tests, *Laboratory equipment, Flocculation, Polymers, Sampling, Settling velocity

E116

QUANTITATIVE DETERMINATION OF ASBESTOS FIBER CONCENTRATIONS,

Beaman, D. R., and File, D. M.

The Dow Chemical Company,
Midland, Michigan.

Analytical Chemistry, Vol. 48, No. 1, p 101-110, January, 1976. 7 fig, 3 tab, 22 ref.

A method of measuring the concentration of asbestos fibers in filterable liquids and solid matrices is presented. In the described method, fiber identification is based on the almost simultaneous determination of the morphology, elemental composition and crystal structure. This is accomplished by using a transmission electron microscope (TEM) equipped with selected area electron diffraction (SAED) and an energy dispersive spectrometer (EDS). Sample preparation, instrumentation and procedure are discussed. Water samples underwent vacuum filtration. Experiments were conducted to determine how much fiber was lost during sample preparation. The mean loss of amphibole fiber for eight different tests was 45% and the mean loss for chrysotile fiber after eleven different tests was 11%. Chrysotile is less prone to wash off than amphibole. Results showed that 40 to 100% of the chrysotile fibers in water samples have distinctive tubular morphology. Identifiable SAED patterns were observed for about 30% of the chrysotile fibers and 60% of the amphibole fibers. By applying corrections for SAED ambiguities and losses during sample preparation and by making allowances for the dependence of fiber composition on fiber size, it was possible to measure asbestos fiber concentrations with a precision of plus or minus 30%. A classification scheme was developed to establish maximum and minimum limits of fiber concentration for each sample.

*Asbestos, *Analytical techniques, *Pollutant identification, *Measurement, Electron microscopy, Water analysis

E117

NASA TO TEST NEW TECHNIQUES FOR ON-STREAM WATER MONITORING,

Instrumentation Technology, Vol. 23, No. 6, p 17, June, 1976.

Techniques developed by the National Aeronautics and Space Administration (NASA) to detect microorganisms in water systems on manned spacecraft are being adapted to detect harmful bacteria in the treated water of cities. The new processes are incorporated in an Automated Water Monitoring System to be evaluated for one year in cooperation with the Gulf Coast Waste Disposal Authority, which is responsible for sewage treatment in three southeast Texas countries. The electronic system will monitor treated water for such components as dissolved oxygen, total oxygen demand, total organic carbon, bacteria, chlorides, residual chlorine, ammonia, nitrate, total nitrogen, sodium, water temperature, turbidity, conductivity, hardness, and acidity or alkalinity. The system can be adapted to process data from up to 40 water sensors. In the initial evaluation, 24 sensors will be used. By adding chemicals which cause bacteria to radiate light, researchers have developed a sensor that gives total bacteria count directly. A device has also been developed that can detect human and nonhuman fecal coliform bacteria in a few hr. The monitoring system eventually will include an instrument to rapidly and automatically detect organic chemicals known to produce cancer in lab animals. A gas chromatograph technique, originally developed to extract small quantities of organic materials from the atmospheres of other planets, is being adapted to concentrate these chemicals for rapid analysis. Research is also in progress on a technique, using fluorescent dyes, designed as a method of detecting life in space, which might be applied to the detection of viruses in water.

*Waste water treatment, *Pollutant identification, *Sewage treatment, *Analytical techniques, *Monitoring, Coliforms, Water types, Automation, Evaluation

E118

INSTRUMENTATION AND AUTOMATION OF WASTEWATER COLLECTION AND TREATMENT SYSTEMS,

Wise, R. H., Roesler, J. F., and Kugelman, I. J.

Environmental Protection Agency,
Cincinnati, Ohio,
Municipal Environmental Research Laboratory.

Journal Water Pollution Control Federation, Vol. 48, No. 6, p 1206-1217, June, 1976.
138 ref.

A review of literature dealing with the instrumentation and automation of waste water collection and treatment systems is presented. Topics covered include: guidelines for selecting on-line process analyzers, design improvements in on-line gas chromatographs, an automatic sampling and monitoring system for detecting accidental spills or other abnormally high discharges in industrial sewers, the evaluation of a commercial venturi that uses metal-membrane protected piezometers to detect fluid pressure changes, waste water treatment and water pollution abatement applications of a sonar-in-air liquid flow meter, the usefulness of existing optical methods for measuring turbidity, developments in control valves and flow control technology, the advantages of solid-state timing devices over electromechanical switches and timers, approaches to the real-time control of waste water variables, the design of fully automated water treatment plants, the use of computer control in an automated activated sludge plant, and criteria for selecting a data acquisition system.

*Automation, *Automatic control, *Waste water treatment, *Treatment facilities, *Instrumentation, Sampling, Monitoring, Flow measurement, Computers, Equipment, Activated sludge, Data processing, Flow control

E119

CONTINUOUS MONITORING, AUTOMATED ANALYSIS, AND SAMPLING PROCEDURES,

Brezonik, P. L., and Carriker, N. E.

Florida University,
Gainesville,
Department of Environmental Engineering Sciences.

Journal Water Pollution Control Federation, Vol. 48, No. 6, p 1077-1086, June, 1976.
87 ref.

A review of literature dealing with continuous water quality monitoring, automated analysis, and sampling procedures is presented. General topics covered include: the use of electrometric and spectrometric methods for analyzing inorganic substances, techniques for measuring oxygen demand and organic matter and for performing bioassays, and methods and instrumentation for collecting and preserving water samples. Examples of specific topics discussed under the above general headings include: the use of amperometric methods for residual chlorine determination, the use of potentiometric electrodes for monitoring cations and anions in industrial waste waters, colorimetric methods for chloride and sulfide determinations, turbidity monitoring with a dual beam optical transmissometer, semiautomated procedures for chemical oxygen demand, automated flow-through procedures for measuring dissolved organic carbon in natural waters, devices for monitoring toxic substances when fish are used as the assay organisms, evaluations of commercially available waste water samplers, and sampling and preservation procedures for nitrogen species in drinking water supplies.

*Analytical methods, *Pollutant identification, *Sampling, *Bioassay, Colorimetry, Turbidity, Chemical oxygen demand, Chlorides, Sulfides, Organic compounds, Inorganic compounds, Carbon, Fish, Toxicity, Monitoring, Potable water, Instrumentation, Electrochemistry, Chlorine

Potentiometric methods, Amperometric methods, Spectrometric methods

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E120

ANALYSIS OF NEW CHLORINATED ORGANIC COMPOUNDS FORMED BY CHLORINATION OF MUNICIPAL WASTEWATER,

Glaze, W. H., Henderson IV, J. E., and Smith, G.

North Texas State University,
Denton, Texas,
Institute of Applied Sciences.

In: Proceedings of the Conference on the Environmental Impact of Water Chlorination, October 22-24, 1975, Oak Ridge, Tennessee, Oak Ridge National Laboratory, p 153-175.
9 fig, 4 tab, 14 ref.

Recent data on the formation of new chlorinated organics, particularly with the use of large doses of chlorine (1000 to 4000 mg/liter) are described. Two analytical techniques were used to investigate the effect of chlorination on secondary municipal waste water effluents. Total organic-bound chlorine (TOCl) is measured before and after chlorination by a microcoulometric procedure, whose development is reported. Extracts of the effluent before and after chlorination at various dosages are pyrolized and titrated in the Dohrmann halide analyzer. The TOCl results show a significant increase in the level of organic-bound chlorine in municipal waste water after chlorination, particularly using large doses of chlorine (2000 to 4000 ppm). The concentrates obtained by XAD-2 resin extractions of the effluents were studied by gas chromatography/mass spectrometry. The results confirm that chlorination causes the formation of many new chlorinated organics; the structures of over 50 have been identified. Although most of the compounds are aromatic halides, many are not derivatives of "activated" aromatics but are simple derivatives such as chlorobenzenes, -toluenes, and -alkylbenzenes. Nonaromatic chlorides were also identified. The TOCl and GC/MS results indicate that doses of chlorine in the range of 2000 to 4000 ppm cause a very large increase in organic-chlorine content. GC/MS data on XAD extracts of Denton, Texas, drinking water are also reported. The occurrence of the three compounds dichloroiodomethane, dibromoidomethane, and bromochloriodomethane, in the finished water is of interest.

E121
CHLORINATED COMPOUNDS FOUND IN WASTE-TREATMENT EFFLUENTS AND THEIR CAPACITY TO BIOACCUMULATE,

Kopperman, H. L., Kuehl, D. W., and Glass, G. E.

University of Minnesota-Duluth,
Duluth,
Department of Chemistry.

In: Proceedings of the Conference on the Environmental Impact of Water Chlorination, October 22-24, 1975, Oak Ridge, Tennessee, Oak Ridge National Laboratory, p 327-345. 4 fig, 7 tab, 21 ref.

To assess possible long-term environmental effects due to the formation of stable reaction products during disinfection processes, fathead minnows and water from the 9 month chronic toxicity tests at two waste water treatment plants were analyzed for chemical residues. Gel permeation chromatography was used for sample clean-up and gas chromatography/mass spectrometry for sample analysis. Di- and trichlorophenols, di- and trichlorobenzenes, and trichloroanisoles were detected at lower levels, if at all, in the fish from nondisinfected effluent exposures as compared to fish exposed to chlorinated effluent. All fish raised in the sewage effluent contained tetra- and pentachlorophenols, PCB's, DDT's, toxaphene components, chlordane, and nonachlor. Tribomoanisole was tentatively identified in fish that lived in waste water treated with bromine chloride. The incorporation of chlorine into compounds when it is used to disinfect effluents is an undesirable end result of effluent treatment in that compounds become more persistent and bioaccumulate to a greater extent.

*Waste water treatment, *Pollutant identification, *Sewage treatment, *Analytical techniques, Sewage effluents, Disinfection, Minnows

Chlorinated compounds, Bioaccumulation

E122
ISOLATING ORGANIC WATER POLLUTANTS: XAD RESINS URETHANE FOAMS, SOLVENT EXTRACTION,

Webb, R. G.

Environmental Protection Agency,
Athens, Georgia,
Southeast Environmental Research Laboratory.

June, 1975. 21 p, 2 fig, 2 tab, 12 ref. Technical Report PB-245 647.

Macroreticular resins (XAS-resins) and urethane foams were investigated as adsorbents for the isolation of organic pollutants from water. The procedures and reagents for solvent extraction were also examined for inefficiencies. XAD-2, 4, 7, and 8 and various mixtures effectively extracted a broad range of individual industrial pollutants and mixtures typical of paper mill waste waters, dissolved fuel oil, and textile dyes. Typical resin recovery efficiences were 65 to 75% for individual compounds; direct chloroform extraction efficiency was 80%. These resins may be useful in long term or composite sampling. Polyurethane foams were not effective in extracting many compounds found in industrial effluents, although they function well for PCB's. Either chloroform or methylene chloride is generally recommended over diethyl ether or hexane as an extraction solvent. Drying of chloroform extracts before evaporation was shown to be unnecessary; drying with sodium sulfate or glass wool resulted in lower recoveries than direct concentration without drying. For typical industrial effluents, extract concentration to 10 ml with a Kuderna-Danish evaporator and to as low as 0.3 ml with a micro-Snyder column resulted in greater recovery of dissolved organics than did rotating evaporators and airstream-waterbath methods. Extraction with tetralin sometimes allows nonpolar low-boiling pollutants to be detected that are usually obscured in gas chromatographic analysis by the solvent peak.

*Pollutant identification, *Analytical techniques, *Separation techniques, *Solvent extractions, *Resins, Adsorption, Chromatography, Drying, Gas chromatography

E123
DESIGN AND TESTING OF A PROTOTYPE AUTOMATIC SEWER SAMPLING
SYSTEM,

Shelley, P. E.

EG and G Washington Analytical Services Center, Incorporated,
Rockville, Maryland.

March, 1976. 106 p, 27 fig, 2 tab, 12 ref, 1 append. Technical Report
EPA-600/2-76-006.

The characteristics of storm and combined sewer flows are briefly reviewed. These are difficult to accurately characterize in a water quality sense due to the wide range of pollutants, the possible spatial variations within a cross-section of the flow, widely varying flow rates, the frequent presence of significant bed load, and debris which may harm the sampler. The requirements for samplers are discussed. Due to the large number of highly varying parameters, a systems approach to designing an automatic sampler is virtually mandatory; the essential elements of such a system are the sampler, intake subsystem, the sample gathering subsystem, the sample transport subsystem, the sample storage subsystem, and the controls and power subsystem. A new automatic sewer sampling system was built using a modular approach, which allows the basic design implementation to be tailored to suit various sampling and site requirements. It incorporates all solid-state electronics, a clock for time correlation, high sample intake and transport velocities, large peristaltic pumps and fluidic diverters to avoid moving parts in the sample train, the return of the first flow to waste, a fresh water purge and backflush before and after collecting each sample, multilevel sample intakes with non-intrusive mounting, and large sample capacity. The prototype performed well when field tested in a sewer. It was also tested with synthetic sewage under laboratory conditions and found capable of gathering reasonably representative samples over a range of flow characteristics. Four commercial samplers were tested side by side with the prototype under laboratory conditions and their results ranged from an overall understatement of pollutant loading by 25% to overstatements of 200%.

*Pollutant identification, *Sewerage, *Sampling, *Sewage, *Water analysis, Water quality, Water pollution, Effluents, Storm drains, Combined sewers, Sanitary engineering

E124
RECOMMENDED DESIGN OF SAMPLE INTAKE SYSTEMS FOR AUTOMATIC
INSTRUMENTATION,

Lauch, R. P.

United States Environmental Protection Agency,
Cincinnati, Ohio,
Environmental Monitoring and Support Laboratory.

November, 1975. 29 p, 4 fig, 6 tab, 7 ref. Technical Report EPA-600/4-75-012.

The biochemical and mechanical reasons for sample change on intake systems were studied. Tests were made on different types of pumping systems. Experimental data showed sample degradation because of biological metabolism, cavitation, and aeration. Samples drawn from the river channel are usually representative of most of the water in the stream. High sample velocity through a pipeline of consistent cross section is required, because sample degradation resulting from biological metabolism of sludge and slime microbes within the pipeline should be insignificant. Raw water should flow directly from the river through a pump and to the instrumentation shelter. A positive pressure system with low residence time minimizes mechanical sample change due to cavitation, reaeration, and damping. A system designed for minimal biological sample degradation may not require automatic cleaning. Above a certain sample velocity for a specific line length and exposed internal surface, biological degradation is insignificant. Cursory results show that an optimum velocity is attainable that would eliminate the need for automatic cleaning. Initial design should be aimed toward this optimum system. Access to the intake strainer should be easy, because periodic manual cleaning is required. The design must consider system maintenance. All components must be accessible from the river bank during the most adverse stream conditions.

*Pollutant identification, *Pumps, *Waste water (pollution), *Water quality, *Intakes, Water pollution, Instrumentation, Monitoring

E125
TECHNIQUES FOR OPTIMIZING A QUADRUPOLE GC/MS/COMPUTER SYSTEM,

Carter, M. H.

United States Environmental Protection Agency,
Athens, Georgia,
Environmental Research Laboratory.

March, 1976. 33 p, 11 fig, 6 ref, 2 append. Technical Report EPA-600/4-76-004.

Using experience gained during 4 years of analyzing various types of organic pollutants, techniques and procedures were developed to maintain the stability and maximize the sensitivity of the Finnigan 1015-System 150 Gas Chromatograph/Mass Spectrometer/Computer (GC/MS/Computer) System. Poor vacuum tube performance and high temperature in the electronics chassis can cause instability. Appropriate maintenance and adjustment techniques maximize sensitivity. Appropriate operator techniques are essential in maintaining sensitivity and stability. Methods developed for increasing the utility of the data collected by the GC/MS/Computer system include techniques for acquiring better data and for extracting the most information from the data that have been acquired. Operator actions can significantly improve the utility of the data.

*Pollutant identification, *Analytical techniques, *Optimization, *Computers, Organic compounds, Stability, Gas chromatography, Mass spectrometry

E126
HANDBOOK FOR EVALUATING WATER BACTERIOLOGICAL LABORATORIES,

Geldreich, E. E.

United States Environmental Protection Agency,
Cincinnati, Ohio,
Municipal Environmental Research Laboratory.

August, 1975. 206 p, 6 fig, 11 tab, 319 ref. Technical Report EPA-670/9-75-006.

The material included is designed to provide a comprehensive source of information and reference for the evaluation of laboratories involved in bacteriological testing of potable water supplies and their sources. A similar document published by the Public Health Service in 1966, based on experience in evaluating bacteriological laboratories responsible for the examination of water supplies, is updated and expanded. Material and media preparation, equipment needs and specifications, sample collection and handling, bacteriological methodology, quality control considerations, laboratory management, and the qualifications and responsibilities of the survey officer are considered. Specific topics include monitoring response, multiple tube coliform procedures, and membrane filter coliform procedures. The handbook is intended to assist in the evaluation of the many aspects of the laboratory that are involved in attaining reliable data. Testing of natural recreational waters, streams, sediments and sludges as well as potable water sources is included.

*Pollutant identification, *Analytical techniques, *Potable water, *Water supply, *Laboratories, *Evaluation, Bacteria, Publications, Water quality standards, Personnel, Data collection

E127

PERFORMANCE OF THE ISCO MODEL 1391 WATER AND WASTEWATER SAMPLER,

Lauch, R. P.

United States Environmental Protection Agency,
Cincinnati, Ohio,
National Environmental Research Center.

February, 1975. 37 p, 5 fig, 21 tab, 1 append. Technical Report PB-240-700.

The performance of the ISCO model 1391 water sampler performance was tested. Accuracy and precision of the timer, flowmeter, and sample volumes were tested at 2, 19, and 35 C. Discrete sample temperatures were determined at different times under iced conditions. The sampler has an accurate timer. Its precision is excellent for runs that are in multiples of one hour, however precision of other runs was not as good and this variation is due to the manufacturer's method of initiating a signal from the timer. In special cases, better precision may be required. Occasionally, contact bounce of the timer actuated reed switch caused spurious cycles. Variation in sample size was not excessive. The multiplexer function of delivering multiple aliquots per bottle was satisfactory. The flowmeter performed satisfactorily after calibration. Flowmeter precision decreases with decreasing flows. There was no difference in operation between converter or battery power. The company's claim for the sampler operation, collecting 100 samples of 500 ml each, was exceeded. The company's claim of maintaining samples 22.2 C below ambient for 24 hours is not always correct, as shown by thermocouple readings on discrete samples. For eight samples of a low-temperature, high-humidity run, the pump did not reverse. This problem might be eliminated by changing the desiccant. Improvement is warranted for some sampler components, but most of the manufacturer's claims were confirmed.

*Pollutant identification, *Water sampling, *Evaluation, *Performance, Timing, Water pollution, Flowmeters, Water temperature

*Samplers

E128

DISINFECTION KINETICS OF ALGAL-BACTERIAL SYSTEMS,

Venkobachar, C., Devkota, I. C., and Rana, D. S.

Indian Institute of Technology,
Kanpur,
Department of Civil Engineering.

Indian Journal of Environmental Health, Vol. 18, No. 1, p 26-32, 1976. 3 fig, 2 tab, 10 ref.

Laboratory investigations on the disinfection kinetics of algal-bacterial systems were conducted to investigate the feasibility of using oxidation pond effluents for the irrigation of edible crops. Residual chlorine curves indicated that chlorine consumption is a complex process in algal-bacterial systems and appears to be due to the oxidation of complex organic components, dead bacteria, and algal cells. Kinetic data indicated a deviation from Chick's Law, with the rate of disinfection being a function of the time of contact, disinfectant concentration, number of organisms exposed, and the temperature of the medium. The kinetics of chlorination did not follow a first order reaction. The maximum dose of chlorine employed (25 mg/liter) reduced the coliform count to 100/100 milliliters within 10-15 minutes.

*Disinfection, *Chlorine, *Oxidation lagoons, *Kinetics, *Coliforms, Bacteria, Algae, Organic compounds, Waste water treatment, Laboratory investigations

E129
DEVELOPMENT OF WATER QUALITY SAMPLING PROGRAMS,

Bourne, R. G.

Simulation Network Newsletter, Vol. 8, No. 2, p 1-8, March, 1976. 2 fig, 1 tab.

Procedures are described which should be followed in developing a sampling program that provides data not only characteristic of water quality within the system but also that meet requirements necessary for use by the selected model. A study for the Central Midlands Regional Planning Council (CMRPC) is used to illustrate the development of such a sampling program. The scope of the sampling program is defined by the overall goals and objectives of a water quality study. Awareness of model requirements is also essential to the development of a sampling program which provides homogeneous data series acceptable to the model. Data which are not representative of temporal and spatial variations in the system have little value. The first step in designing a water quality sampling program is determining the goals and objectives of the water quality study. The sampling program should then be designed as a function of the goals and objectives. The model which is best suited to providing the necessary analyses required to meet the goals and objectives of the study should then be selected. The sampling program should then be re-examined and altered if necessary to assure that the input requirements of the model will be satisfied by the data.

*Analytical techniques, *Water quality, *Water sampling, *Programs, *Data collections, Model studies, Analysis, Planning, Sampling

E130
(NO TITLE),

Crawford, N. H.

Simulation Network Newsletter, Vol. 8, No. 1, p 1-4, January, 1976. 2 fig.

Technical advances important to hydrology and water resources are taking place in computer hardware, communications, and software design. A water resource management system requires orderly organization of information, analysis of the consequences of decisions, operational criteria, and a means to implement the decisions that are taken. The most important current trend in computer hardware is toward ultra small and inexpensive logical components. A microcomputer can be built into a raingage or a streamgage, giving these devices decision making power. Transmission of field data to satellites, followed by readout into a data bank is currently being tested in the United States. Such a system is practical even if the data are not used in real-time, if the satellite can collect data at lower cost than the alternate field trip to the gage site. Software needs include data base systems that store, update, and retrieve time series; simulation software to investigate policy and development alternatives; system management software to locate optimum or near optimum control strategies; and interactive or conversational linkages between the user and the other types of software. The cost of software in water resource systems already exceeds the hardware costs and will probably increase.

*Pollutant identification, *Analytical techniques, *Technology, *Hydrology, *Water resources, Computers, Communication, Analysis, Water resources development

E131

SIMPLE METHOD MEASURES SUSPENDED SOLIDS,

Rich, D. F., VanSurdam, J. R., and Karr, P.

American Enka Company,
Clemson, South Carolina.

Water and Sewage Works, Vol. 123, No. 7, p 46-47, July, 1976. 3 ref.

A simple method for estimating the amount of suspended solids in a clarifier is described which gives more accurate results than those obtained by the conventional method of multiplying the mixed liquor suspended solids concentration by the clarifier volume. The method involves lowering an open-ended plexiglass tube in the clarifier. When this tube reaches the clarifier bottom, a hinged stopper mounted on the bottom of the tube is pushed into the end of the plexiglass tube, thereby sealing it. The tube is then withdrawn from the clarifier and its contents dumped into a container and thoroughly mixed. Suspended solids determined on a sample taken from this container represent the average solids concentration in a vertical plane through the clarifier. Multiplying this concentration by the volume of the clarifier provides a better estimate of the amount of solids in the clarifier. A commercial sampler for employing the above technique has been built at a total cost of $38.00 which covers the tube assembly parts, mast, and hoist.

*Analytical techniques, *Suspended solids, *Measurement, *Sampling, *Equipment, Costs, Performance, Water quality control, Waste water treatment

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E132

APPLICATIONS OF AUTOMATIC EQUIPMENT TO WATER ANALYSIS,

Thomson, D. G.

Process Biochemistry, Vol. 11, No. 5, p 44-45, June, 1976. 3 tab.

Advances in the automation of water analysis equipment are reviewed. An automatic analyzer capable of measuring thiocyanate, phenols, cyanide, ammonium ion, phosphate, and nitrate/nitrite is described along with its application to coke oven effluent monitoring. An automatic instrument for measuring chemical oxygen demand involves the use of an aluminum heating block which can be programmed by the operator. A self-contained series of reflux heads fits directly onto the system, thus allowing the simultaneous digestion of up to 20 samples over an exactly timed and temperature controlled interval. The digested sample is then transferred to sample cups where chemical oxygen demand is determined automatically. An automatic analyzer capable of measuring nitrite, total organic nitrogen, phosphate, ammonia, chloride, and silica is also described. The instrument is capable of handling 60 samples/hour and has the capacity for up to 12 channels.

*Pollutant identification, *Analytical techniques, *Automation, *Monitoring, Phenols, Ammonium compounds, Phosphates, Nitrates, Nitrites, Chemical oxygen demand, Nitrogen, Ammonia, Chlorides, Silica, Equipment

Cyanide, Thiocyanate

E133
MULTIELEMENT AND CHLORINATED HYDROCARBON ANALYSIS OF MUNICIPAL SEWAGE SLUDGES OF AMERICAN CITIES,

Furr, A. K., Lawrence, A. W., Tong, S. S. C., Grandolfo, M. C., and Hofstader, R. A.

Virginia Polytechnic Institute,
Blacksburg,
Nuclear Reactor Laboratory.

Environmental Science and Technology, Vol. 10, No. 7, p 683-687, July, 1976.
2 tab, 32 ref.

Data from an analytical survey of 68 elements, dieldrin, and polychlorinated biphenyls conducted on municipal sewage sludges sampled during 1972-1973 from 16 American cities are reported. Fluorine levels were high for several cities which fluoridate their water. The level of polychlorinated biphenyls was highest for Schenectady, New York and was possibly the result of wastes generated by a predominant manufacture of electrical equipment in the city. Levels of gold were especially high in Miami and San Francisco sludges. Mercury was also high in these same two sludges. The high levels of both metals may be due to geochemical sources. A number of elements were notably high in sludges from other specific cities. These included: antimony, copper, and lead (Philadelphia); nickel (Denver, Los Angeles, Miami, Milwaukee, and Philadelphia); barium (Ithaca and Los Angeles); and zinc (Los Angeles and Philadelphia).

*Sewage sludge, *Pollutant identification, *Dieldrin, *Polychlorinated biphenyls, *Trace elements, Cities, Surveys, Fluorine, Gold, Mercury, Copper, Lead, Nickel, Zinc, Municipal wastes

Barium, Antimony, Chlorinated hydrocarbons

E134
EVALUATING POLLUTION-PRONE STRATA BENEATH SEWAGE LAGOONS,

Leisch, B.

Public Works, Vol. 107, No. 8, p 70-71, August, 1976. 2 fig.

The use of electrical resistivity and seismic techniques for evaluating pollution-prone strata beneath lagoons is discussed. Refraction seismic studies can determine the physical characteristics and thickness of the underlying geologic formations. Earth resistivity measurements can then be used to develop greater detail in terms of porosity and permeability of consolidated or unconsolidated formations. An example illustrating the application of the above techniques for evaluating a sewage lagoon site is presented. An analysis of the data obtained from seismic and resistivity measurements indicated that voids in sandstone or underlying dolomite had developed initially through the action of descending groundwater along joints and fissures. The study also revealed the need for upgrading lagoon seal specifications.

*Lagoons, *Stratigraphy, *Sewage treatment, *Hydrogeology, *Geologic mapping, *Groundwater, Seismic studies, Resistivity, Analytical techniques

E135

CADMIUM ACCRUAL IN COMBINED WASTEWATER TREATMENT-AQUACULTURE SYSTEM,

Kerfoot, W. B., and Jacobs, S. A.

Environmental Management Institute,
Marion, Massachusetts.

Environmental Science and Technology, Vol. 10, No. 7, p 662-667, July, 1976.
8 fig, 2 tab, 22 ref.

Trace amounts of cadmium were added to isolated links of a sewage/seawater-plankton-shellfish food chain employed in a prototype tertiary treatment-aquaculture system. Accumulation of the metal was studied in two types of phytoplankton, a green platymonad (Prasinocladus tricornutum) and a mixture of diatoms (predominantly Phaeodactylum tricornutum and Chaetoceros simplex), as well as in two species of shellfish, the American oyster (Crassostrea virginica) and the hard clam (Mercenaria mercenaria). The algae showed a rapid increase in metal concentration until an equilibrium was reached proportional to the initial concentration introduced. Shellfish species exhibited a continual increase in concentration when exposed to sea water and algae mixtures contaminated with cadmium. Separation of the two pathways of transfer identified the algae as the principal source of accumulation in the aquaculture system. A rate of cadmium increase amounting to 0.003 micrograms/day was computed to be sufficient to yield a critical concentration of the metal for 3-year-old shellfish.

*Aquiculture, *Sewage treatment, *Tertiary treatment, *Cadmium, *Algae, *Shellfish, Heavy metals, Toxicity, Phytoplankton, Sea water, Waste water treatment, Liquid wastes, Metals

E136

INSTRUMENTATION IN THE WATER INDUSTRY,

Water Services, Vol. 80, No. 964, p 370, 372, June, 1976.

A technique for measuring and recording effluent flow is described. The technique employs a vee-notch weir tank in the effluent channel in which the head of liquid over the weir has a known relationship to the rate of flow. A dip-tube fed with compressed air in the tank converts the head of liquid into a pressure which is fed to a suitably calibrated liquid flow recorder. If it is not practicable to fit a weir tank, the recorder can be used in conjunction with a venturi flume. The use of a vee-notch weir plate is preferred because it has the advantage that the shape of the issuing jet is geometrically similar at all heads. This makes it possible to use a standard scale shape for the recorder and gives interchangeability of chart ranges. As in all weir plate measurements, the liquid should be practically motionless apart from the movement of particles towards the notch. In practice this is achieved by fitting the weir plate in the side or end of a tank at a point remote from the notch.

*Flow measurement, *Monitoring, *Effluents, *Weirs, Hydraulic structures, Flow, Engineering structures, Analytical techniques, Liquid wastes, Flow rates

E137

MAINTENANCE MANUAL: INSTRUCTIONS FOR SENSOR CLEANING AND FIELD CALIBRATION. THE POTOMAC RIVER WATER POLLUTION MONITORING SYSTEM,

Mentink, A. F.

Federal Water Pollution Control Administration,
Cincinnati, Ohio,
Division of Pollution Surveillance.

September, 1966. 31 p, 3 append. Technical Report PB-245 783.

A very important, but underemphasized, aspect of automatic acquisition systems for water quality data is maintenance of field instrumentation. The sensitivity of the electrodes decreases as contaminants accumulate on them. The more rigorous and disciplined the program of maintenance, the higher the probability of getting useful and valid data. Instructions for first-level maintenance (sensor cleaning and field calibration) are covered. The parametric systems discussed include pH, conductivity, dissolved chlorides, dissolved oxygen, oxidation-reduction potential, solar radiation intensity, and temperature.

*Pollutant identification, *Analytical techniques, *On-site data collections, *Automation, *Automatic control, Water quality, Maintenance, Instrumentation

E138

A PASSIVE FLOW MEASUREMENT SYSTEM FOR STORM AND COMBINED SEWERS,

Foreman, K. M.

Grumann Aerospace Corporation,
Bethpage, New York,
Research Department.

May, 1976. 137 p, 71 fig, 1 tab, 6 ref. Technical Report EPA-600/2-76-115.

A new, nonintrusive, low cost, passive flow measurement method to meet the urgent needs for good management of storm and combined sewer systems was investigated. The system is based on sensing the near field sound emitted by the disturbed flow at a channel discontinuity. These local pressure pulses, called pseudosound, radiate as dipole sound sources orthogonal to the flow direction. Flow rate is indicated by the output signal of passive transducers, such as accelerometers, attached to the outer wall of the channel, after processing by a Fourier Analyzer. Laboratory tests using full scale sewer pipe elements and a brief series of field tests measuring sanitary sewage flow demonstrated its feasibility for channels where a discontinuity exists because of a conduit cross-sectional increase. The acoustic emission has been found to produce unambiguous signals that increase in magnitude as the fluid flow rate increases. Low cost accelerometers having a wide range of voltage sensitivities, between 10 and 100 mv/g, were found to be well suited to the acoustic monitoring function. Inexpensive but effective techniques to properly simulate sewer installations were developed. The most reliable unambiguous signal for flow rate measurement is the acoustic emission component at a characteristic frequency, which is inversely proportional to the maximum geometric step at the discontinuity and directly proportional to the bulk sound speed of the fluid. Qualitative evaluation of total sound content from various and diverse remote sites can provide a mental image of local sewer conditions that almost rivals in situ observations by a mobile crew, but with greater convenience and lower cost. Recommendations for further field site testing using an instrumented sewer line are made.

E139
SELF-MONITORING PROCEDURES: BASIC LABORATORY SKILLS(164.6I)
(STAFF GUIDE),

Schwing, C. M.

Charles County Community College,
LaPlata, Maryland.

June, 1975. 131 p, 3 fig, 13 tab, 19 ref. Technical Report PB-244 919.

This Basic Laboratory Skills course is designed for treatment plant operators or technicians who must monitor effluent discharges under a National Pollutant Discharge Elimination System (NPDES) permit and who have little prior laboratory experience. The instructor's manual contains all the instructional package worksheets for presenting the course. The mathematical material includes whole numbers, decimals, the metric system, percentage, and formulas. The chemical laboratory material contains such applications as weighing techniques, laboratory equipment use, and preparing and standardizing reagents. Basic microbiological techniques are also introduced.

*Waste water treatment, *Pollutant identification, *Analytical techniques, *Treatment facilities, *Mathematics, Effluents, Measurement, Microbiology, Engineering education, Volumetric analysis, Laboratory equipment, Education, Chemicals, Sanitary engineers, Bacteria

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E140
VARIABLE NATURE OF CHEMICAL COMPOSITION OF
SEWAGE SLUDGES,

Sommers, L. E., Nelson, D. W., and
Yost, K. J.

Purdue University,
West Lafayette, Indiana,
Agricultural Experiment Station and
Institute of Environmental Health.

Journal of Environmental Quality, Vol. 5, No. 3, p 303-306, July-September, 1976.
6 tab, 11 ref.

Sewage sludge samples were collected over a 2-year period from eight Indiana cities and were analyzed for carbon, nitrogen, phosphorus, potassium, calcium, magnesium, iron, cadmium, zinc, copper, nickel, and lead. The sludges contained approximately 50% organic matter and 1-4% inorganic carbon. Organic and inorganic carbon, organic nitrogen, inorganic phosphorus, calcium, and magnesium were present in a given sludge at a relatively constant concentration with respect to sampling time. Inorganic nitrogen, organic phosphorus, potassium, and all metals were found to be quite variable with time for sewage sludge produced by a given city. In general, organic nitrogen and inorganic phosphorus constituted the majority of total nitrogen and phosphorus, respectively, in sludges. The largest deviations between the mean and median were found for cadmium, zinc, copper, nickel, and lead. The variable nature of inorganic nitrogen and metals in sludges indicates that a sound sampling and analysis program is essential prior to formulating recommendations for rates of sewage sludge application to soils used for crop production.

*Sewage sludge, *Chemical analysis, *Municipal wastes, *Chemical properties, Indiana, Cities, Carbon, Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, Iron, Cadmium, Zinc, Copper, Nickel, Lead, Sludge disposal, Organic compounds

E141
HYDROGEN SULFIDE IN BOTTOM WATER NEAR A SEWAGE SLUDGE DUMPING SITE,

Barvenik, F. W., Hill, F. B., Aneja, V. P., and Felder, R. M.

Brookhaven National Laboratory,
Upton, New York,
Department of Applied Science.

October, 1975. 27 p, 6 fig, 3 tab, 30 ref. Technical Report BNL 20778.

An attempt was made to determine the concentrations of reduced sulfur compounds in bottom water in the vicinity of a sewage sludge dumping site in the apex of the New York Bight and to determine the utility of a field-adapted gas chromatographic system as an analytical tool for such a study. The study site was in the center of a depression which tends to collect sludge sediments; the water depth at the site is about 33 to 34 m. Water from 2 m above the bottom was pumped on board the research ship and then through a gas-liquid contactor. Volatile compounds transferred to the gas phase were passed to the gas chromatograph. The gas chromatographic technique used permits the detection of the entire spectrum of volatile sulfur compounds and, at least for hydrogen sulfide, is considerably more sensitive than the usual wet chemical methods. Although significant peaks were found for hydrogen sulfide, peaks for other sulfur compounds were not clearly evident. Assuming an equilibrium distribution of hydrogen sulfide between gas and liquid phases in the contactor, the concentration of total sulfide dissolved in the bottom water was estimated at 0.03-0.08 microM. The bottom water was partially depleted of dissolved oxygen and contained a small population of sulfate reducers (Desulfovigrio desulfuricans).

*Pollutant identification, *Analytical techniques, *Hydrogen sulfide, *Aquatic environment, *Seawater, Sewage sludge, Sludge disposal, Gas chromatography, On-site investigations

Reduced sulfur compounds, Disposal sites, New York Bight

E142
THE DELINEATION AND GROWTH OF A SLUDGE FIELD,

Griggs, G. B., and Hopkins, T. S.

Institute of Oceanographic and Fisheries Research,
Athens, Greece.

Water Research, Vol. 10, No. 6, p 501-506, 1976. 7 fig, 10 ref.

The effect of discharging untreated domestic sewage from the city of Athens, Greece, on an area of restricted circulation in the upper Saronikos Gulf was investigated by delineating the color, odor, organic carbon, and acoustic reflection properties of bottom sediments. The discharge of untreated sewage via outfall has led to the deposition and growth of a large sludge field, with approximately 9 sq km of the sea floor being covered by black anoxic muds which give off hydrogen sulfide and are essentially devoid of benthic life. The organic carbon content of the muds is over 6% in some areas near the outfall in comparison with normal regional values of less than 0.5%. Seismic reflection characteristics which are believed to coincide with the production of methane gas distinguish a core area around the outfall. The circulation and oxygenation in the upper Saronikos Gulf are not adequate to disperse the waste water from the Athens area, with the result being that the benthic environment is rapidly being destroyed.

*Water pollution effects, *Domestic wastes, *Sewage disposal, *Gulfs, *Sediments, Color, Odor, Organic compounds, Carbon, Hydrogen sulfide, Methane, Sea water, Oxygenation, Circulation, Aquatic life, Toxicity, Acoustics, Analytical techniques, Municipal wastes

Saronikos Gulf, Athens, Greece

E143
COMPLEXATION OF TRACE METALS BY ETHYLENEDIAMINETETRAACETIC ACID (EDTA) IN NATURAL WATERS,

Gardiner, J.

Water Research Centre,
Stevenage. Hertfordshire,
United Kingdom.

Water Research, Vol. 10, No. 6, p 507-514, 1976. 3 fig, 4 tab, 33 ref.

Concentrations of the chelating agent ethylenediaminetetraacetic acid in detergents, primary and secondary sewage, and river water were determined, and a method for calculating the extent of complexation of trace metals by the chelating agent in the presence of calcium and other complexing agents was developed. Ethylenediaminetetraacetic acid was present at an average concentration of 170 micrograms/liter in domestic sewage and at higher concentrations in sewage containing industrial effluents. Calculations revealed that despite the competitive effect of calcium in hard water, ethylenediaminetetraacetic acid at the concentrations found in sewage and river water is sufficient in most cases to complex most of the important trace metals to a considerable extent. The tendency of ethylenediaminetetraacetic acid to keep metal ions in solution could lead to increased trace metal mobility in water courses and a reduced rate of removal of trace metals by adsorption and precipitation in lakes and reservoirs. Chelating agents may also be a factor in stimulating algal growth and in reducing the toxicity of trace metals to fish. Insufficient information exists to establish the net effect of ethylenediaminetetraacetic acid on the aquatic environment, however.

*Chelation, *Organic acids, *Metals, *Sewage, *Surface waters, Chemical analysis, Mathematical studies, Domestic wastes, Water pollution effects, Fish, Algae, Calcium, Ions, Toxicity, Detergents

Complexation, Metal organic complexes, Ethylenediaminetetraacetic acid

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E144
PRECISION AQUARATOR SPEEDS COD DETERMINATION,

Viraraghavan, T.

Water and Sewage Works, Vol. 123, No. 8, p 80-81, August, 1976. 3 fig, 1 tab, 3 ref.

A device which produces rapid and reliable chemical oxygen demand determinations is described that works on the combustion-infrared principle. A 20-microliter sample (homogenized in a Waring blender) is injected by syringe into the instrument. The sample is swept through a platinum catalytic combustion furnace by a stream of dry carbon dioxide which oxidizes the pollutants to carbon monoxide and water. The water is stripped out in a drying tube, and the reaction products are then passed through a second platinum catalytic treatment. The carbon monoxide concentration is then measured by an integral nondispersive infrared analyzer, and the resultant reading is directly converted to chemical oxygen demand by the use of a calibration curve. The method is best suited for oxygen demands in the range of 50-300 milligrams/liter, although operation down to 10 milligrams/liter is feasible.

*Chemical oxygen demand, *Analytical techniques, *Pollutant identification, *Spectroscopy, *Oxidation, Instrumentation, Carbon dioxide, Chemical reactions

Nondispersive infrared analysis

E145
STATE OF THE TECHNOLOGY SEMI-AUTOMATIC CONTROL OF ACTIVATED SLUDGE TREATMENT PLANTS,

Nagel, C. A.

County Sanitation Districts of Los Angeles County,
Whittier, California.

December, 1975. 201 p, 59 fig, 14 tab, 20 ref, 1 append. Technical Report PB-249 067.

Due to varied educational backgrounds of municipal waste water treatment plant operators and the many demands on their time, it is desirable to have instrumentation to aid in running the plant. However, sophisticated equipment is subject to frequent breakdowns, requires skilled maintenance, and can lead operators to over-rely on the equipment without considering the total operation of the plant and the interrelationships among the processes. The theory, design, and operation of continuous on-line instrumentation currently in use by the County Sanitation Districts of Los Angeles County, California are discussed. Computer applications which provide daily operational calculations are described. The five instrument control systems discussed are water level control of influent pumping; density control of primary sludge pumping; and process air, return sludge, and waste sludge control in activated sludge plants. Theory, design, operation and maintenance requirements, and results are discussed for each system. A computer application system provides daily operational parameters to the operators and prepares monthly summary of operations reports. Other computer applications are reviewed, and a subroutine to compare effluent characteristics with discharge limits is included. A computer system, leased or owned, can provide significant advantages in reducing operator time and improving efficiencies. Human errors are largely eliminated and up-to-date information is readily available for review.

*Waste water treatment, *Activated sludge, *Analytical techniques, *Treatment facilities, *Automatic control, Data processing, Waste treatment, Waste water (pollution)

F001

FLOW VELOCITY AS A RATE DETERMINING FACTOR FOR SELF-PURIFICATION IN RIVERS (UBER DEN EINFLUSS DER STROMUNGSGESCHWINDIGKEIT AUF DIE SELBSTREINIGUNG IN FLIESSGEWAESSERN),

Wuhrmann, K., Eichenberger, E., Leidner, H. A., and Wuest, D.

Schweizerische Zeitschrift fuer Hydrologie, Vol. 37, No. 2, p 253-272, 1975. 8 tab, 5 ref.

Experiments have been conducted on the self-purification rate of model rivers using the function of the concentrations of pollutants and the flow velocity. Velocities of 24, 13, and 3.7 cm/sec were employed, with all other parameters remaining constant. Results indicated that the ratio of the rates of substrate transport from the flowing wave to cell surfaces and of active transport in substrate uptake is the determining factor for the rate of self-purification. Contrary to expectation, this ratio decreases rapidly with decreasing water flow velocities. Results were based on the kinetics of active transport.

*Rivers, *Model studies, Flow rates, Flow velocities, Kinetics, Waste assimilative capacity, Self-purification

Active transport

F002

QUALITY CONTROL IN SEWAGE TREATMENT PLANT (Gesuishorijo no shishutsu seigyo),

Nagata, Y., Tomita, T., Takase, I., and Yoshida, S.

Toshiba Rebyu, Vol. 31, No. 1, p 23-26, January, 1976. 3 fig, 6 tab, 2 ref.

Mathematical modelling for sewage treatment processes using the activated sludge method may be discussed both theoretically and experimentally. The Toshiba firm's viewpoints concerning both systems and hardware were expressed. Water quality sensors based on field results have been evaluated. Both mathematical models and present state evaluation were used to compare instrumentation systems.

*Water quality control, *Sewage treatment, *Treatment facilities, Instrumentation, Activated sludge, Mathematical models, Model studies

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F003

MICROFLOCCULATION—COMPARATIVE EXPERIMENTS BETWEEN SINGLE AND DOUBLE LAYER FILTERS WITH IRON AND ALUMINUM SULFATE (MICROFLOCKUNG—VERGLEICHSVERSUCHE ZWISCHEN EIN-UND ZWEISCHICTEILTERN MIT EISEN-UND ALUMINUMSULFAT),

Schalenkamp, M.

Gas-Wasser-Abwasser, Vol. 55, No. 9, p 508-515, 1975. 24 fig, 3 ref.

Microflocculation tests in single and double layer filters with and without iron sulfate and aluminum sulfate were carried out with chlorinated lake water at the Lengg waterworks in Switzerland. Both the filter cycle and the purification efficiency (in terms of turbidity, detritus and phytoplanktons) were poor when aluminum or iron sulfate doses of 8 mg/liter were used. Microflocculation was efficient with 2 mg/liter doses of either iron or aluminum sulfate, particularly aluminum sulfate, and was consistently more efficient than without flocculating agents. Therefore, chlorinated lake water, with a suspended solids content of 5-20 mg/liter, is treated by microflocculation with aluminum sulfate (2 mg/liter). A flocculating aid (0.2 mg/liter) may also be added.

*Water treatment, *Flocculation, Filtration, Filters, Water quality control

Alum, Iron sulfate, Microflocculation

F004

DECISION PERSPECTIVES ON URBAN STORM WATER POLLUTION,

Young, G. K.

GKY and Associates,
Annandale, Virginia.

Water Resources Research, Vol. 12, No. 1, p 94-100, February, 1976. 2 fig, 2 tab, 10 ref.

The major features of an urban runoff, combined sewer system are described and several options for control of water pollution that occurs during rainstorms in urban areas are considered. A macroanalytical approach to defining the problem is presented in which typical values of the variables are assigned and a sensitivity analysis of urban storm-induced pollution to various control measures is demonstrated. This method should work as a screening mechanism to choose between candidate urban areas for the allotment of funds to solve pollution problems. A pollutograph scale may thus be calculated with maximums and ranks, related to the water quality standards, and thus specific control measures tailored for each city may be defined.

*Storm runoff, *Urban runoff, Design, Analytical techniques, Sewerage, Model studies, Decision making, Water quality standards

F005
HYDRAULIC CALCULATION OF SLUDGE PIPELINES IN WASTE WATER TREATMENT PLANTS (De hydraulische berekening van sliowaterleidingen op rioolwaterzuiveringsinstallaties),

Noz, F. J.

Procestechniek, Vol. 30, No. 26, p 871-876, December, 1975. 2 fig, 2 tab, 13 ref.

Hydraulic calculation and recommendations for the design of sludge pipelines in waste water treatment plants are presented with special regard to parameters influencing the sludge flow. The formulas proposed by Bingham and Babbitt-Caldwell are discussed. A minimal flow speed of 0.60 m/sec, and optimal speeds between 1.50-2.40 m/sec are recommended for gravity pieplines. The minimal pipe diameter should be 10-15 cm. Gas pockets should be avoided. Pump stations should be provided with centrifugal pumps for primary sludge and for large pipe diameters, or with reciprocating pumps with non-clogging impellers. The suction pipe should have a minimal diameter of 0.15-0.20 m, and the delivery pipe should be at least 0.10-0.20 m in diameter. The suction opering of the pump should be at least 0.60 m below the lowest water level.

*Pipelines, *Sludge, *Hydraulics, *Waste water treatment, Treatment facilities, Equipment, Pipes, Flow rates, Design criteria, Model studies

Sludge pipelines

F006
DESIGN OF NATIONWIDE WATER-QUALITY-MONITORING NETWORKS,

Pickering, R. J., and Ficke, J. F.

U.S.G.S.,
National Center,
Reston, Virginia.

American Water Works Association Journal, Vol. 68, No. 2, p 82-85, February, 1976. 2 fig, 1 tab.

The usefulness of a water quality monitoring network depends upon the water quality characteristics to be measured, the sites at which these measurements are to be taken, the frequency of measurement for each characteristic and at each point and the statistical parameter chosen to report each characteristic. In designing the type of water data network, one must define the function of the network and the geographic scope. The differences between surface water quality monitoring and groundwater monitoring are related to accessibility of sampling and patterns of measurements. Data to provide a measure of the quality of the United States' major rivers has been gathered by the National Stream Quality Accounting Network (NASQAN), consisting of 325 hydrographic data collection sites. While networks are applicable to deriving general patterns, it is too costly to design an all-purpose water quality monitoring network which includes all the facets of physical, chemical, and biological water quality. Specific objectives of any monitoring program should be outlined so that a proper mix of sampling sites, characteristics to be measured, and frequency of measurement may be selected. Information gathered through such networks should be in the form most suited to the needs of environmental planners and administrators.

*Monitoring, *Water quality control, *Measurement, *Data collections, *Networks, Surface waters, Groundwater, Rivers, Administration, Planning, Design

F007
PROBABILITY MODELS OF WASTEWATER TREATMENT PLANT OPERATION,

Bulkley, J. W.

Journal of Hydrology, Vol. 28, No. 2/4, p 317-329, February, 1976. 2 fig, 3 tab, 4 ref.

Mathematical probability models have been used to evaluate the data from waste water treatment facilities and to compare performance data with planned design standards. Three years of daily operating data from a waste water treatment plant at Ann Arbor, Michigan, were studied. Parameters investigated were Voltaire suspended solids, biochemical oxygen demand, and total phosphorus. Statistical analyses showed that once chemical processes for phosphorus removal had been stabilized, the removal efficiencies of both volatile solids and BOD improved significantly and could be represented by normal distributions. Precipitation of phosphate through the addition of ferric chloride resulted in a noticeable improvement in subsequent BOD and suspended solids removal in the secondary treatment phase of plant operation. However, no parameter variation has been performed to find range differences which are not significant for the assumed distribution.

*Waste water treatment, *Model studies, *Treatment facilities, *Phosphorus, *Operation, Biochemical oxygen demand, Suspended solids, Chemical precipitation

F008
DESIGN PROCEDURE FOR A CONTACT STABILIZATION ACTIVATED SLUDGE PROCESS,

Benefield, L. D., and Randall, C. W.

Virginia Polytechnic Institute,
Blacksburg,
Department of Civil Engineering.

Journal Water Pollution Control Federation, Vol. 48, No. 1, p 147-152, January, 1976. 2 fig, 11 ref.

One widely used modification of the activated sludge process is contact stabilization. The development of design equations for this process by using concepts proposed by Eckenfelder and Lawrence and McCarty is presented. The typical flow scheme for the contact stabilization activated sludge process is illustrated. The design procedure entails selection of the desired effluent substrate concentration, selection of desired solids concentration for the contact tank, selection of the desired sludge age, plotting of the variation of sludge volume index with sludge age, calculation of the expected solids concentration in the underflow from the secondary clarifier, operation of the stabilization tank at a solids concentration equal to the solids concentration of the underflow from the secondary clarifier, determination of kinetic coefficients, calculation of the hydraulic detention time in the contact tank, and substituting the proper values into a formula to obtain the required kinetic volume for the contact tank. Equations for each of these steps are provided, as well as details of how to further obtain the volume of the secondary clarifier. Although many assumptions were made to develop this design procedure, it is expected that it will provide the engineer with a design applicable for determining a desired treatment.

*Activated sludge, *Design criteria, *Waste water treatment, *Equations, Mathematical models

F009

CRITERIA FOR SELECTING A WATER QUALITY MODEL FOR 208 PLANNING,

Debo, T. N., and Lumb, A. M.

Simulation Network Newsletter, Vol. 6, No. 2, p 1-5, August 15, 1975. 1 ref.

Section 208 of the Federal Water Pollution Control Act Amendments of 1972 sets forth a planning program whose results will be used for the allocation of waste load and construction funds for pollution abatement. Modeling will be used to extend the results of short-term monitoring and sampling to construct an adequate data base. It will also be used to predict the effects of various land use and growth alternatives and water quality management plans on water quality. General criteria for model selection were developed in two 208 studies in South Carolina. The model must be able to analyze small and large streams and lakes and to adjust to changes in program objectives. It must also represent all major processes and interrelationships in the real system. The model must be able to handle non-equilibrium conditions. The model should have flexibility in the number of processes simulated, the number of segments of the aquatic system analyzed, and the time period simulated. It should also be able to continuously simulate water quality for several years and consider weather conditions in the analysis of nonpoint sources. Costs from computer use, program adaptation and maintenance, modification to specific needs, training time, and time for input preparation and application must be considered together with effectiveness of the model. Detailed criteria will be different for individual areas.

*Water quality control, *Planning, *Model studies, Water quality standards, Long-term planning, Land use

*208 planning, Federal Water Pollution Control Act Amendments

F010

MATHEMATICAL MODEL SIMPLIFIES DESIGN OF SLUDGE DRYING BEDS,

Walski, T. M.

Waterways Experiment Station,
Vicksburg, Mississippi.

Water and Sewage Works, Vol. 123, No. 4, p 64-65, April, 1976. 2 fig, 1 tab, 5 ref.

Sand drying beds for the dewatering of sludge from small waste water treatment plants have proven economical. A typical sand drying bed is made up of a top layer of sand with an effective grain size of 0.3 to 0.75 mm, underlain by 6 to 12 inches of graded gravel. Wet sludge is placed on the beds, where it drains and dries until it can be lifted and hauled away. Design methods for sizing the beds are detailed, using a rational method to tabulate total bed area required each month. While the rational method is preferred over the empirical formula, it is still awkward to use. A simpler mathematical formula has been derived to account for the major sludge drying mechanism. This model is based on the time for sludge to drain, time for moisture to evaporate from drained sludge, moisture in inches, percent solids, and monthly rainfall. It was demonstrated that the required drying bed area was relatively insensitive to the depth to which the sludge is applied but was quite sensitive to variations in solids concentrations and to the effective evaporation.

*Mathematical models, *Dewatering, *Sludge treatment, Equations, Waste water treatment, *Treatment facilities, Sludge disposal, Evaporation

Sludge drying beds

F011

DESIGN OF A STORMWATER SEWER BY NONLINEAR PROGRAMMING--1,

Lemieux, P. F., Zech, Y., and Delarue, R.

Sherbrooke University,
Quebec,
Department of Civil Engineering.

Canadian Journal of Civil Engineering, Vol. 3, No. 1, p 83-89, March, 1976.
3 fig, 10 ref.

Methodology for the design of a stormwater sewer using nonlinear programming has been developed. Pipe flows are calculated at the critical time for the system, using the hydrologic characteristics of the drainage surface. Next, a set of constraints are established for every pipe according to the pipe layout. Thirdly, an optimal solution is found by minimizing the system total cost subject to the constraints defined. A value is then added to the value of every continuous pipe diameter, and the highest standard diameter below or equal to that value is chosen. Finally, a post-optimal analysis is made of the piezometric surface to evaluate the sewer system performance. While the standard diameter solution is not optimal in a mathematical sense, it does lead to efficiency of design. Factors which influence an optimal solution are the inlet time at a node, escavation in soil or rock, ground slope, and Manning's n.

*Mathematical models, *Design criteria, *Sewers, *Pipes, Model studies, Hydrology, Cost analysis, Sewage treatment, Storm water, Drainage

Nonlinear programming

F012

DESIGNING MICROSCREENS? HERE'S SOME HELP,

Saffran, E. P., and Kormanik, R. A.

Envirex, Incorporated,
Waukesha, Wisconsin,
Water Quality Control Division.

Water and Wastes Engineering, Vol. 13, No. 4, p 41-42, 44-45, April, 1976. 4 fig, 1 tab.

In determining the hydraulic capacity of a microscreen for design purposes, several parameters must be taken into account. These include the rate of clogging of the fabric, the rotational speed of the drum, the area of the submerged screen, the backwash efficiency, and the total head. Mathematical formulae have been derived for calculating filterability, headloss, and the permeability coefficient. Equations and their derivations are presented. Microscreens are used in conventional sewage treatment plants to polish secondary effluent. They have been effective in removing up to 50 to 80% suspended solids, 30 to 50% BOD, and 20 to 50% turbidity. The microscreens are generally sized based on hydraulic loadings in terms of gallons per minute per square foot of submerged area.

*Hydraulic design, *Mathematical models, *Model studies, *Equations, *Sewage treatment, *Biochemical oxygen demand, *Suspended solids, Screens, Turbidity, Filtration

*Microscreens

F013
COST-EFFECTIVE GOAL,

Wright, D. E.

The Consulting Engineer, Vol. 40, No. 2, p 37, 39, February, 1976.

An optimization study on sewage treatment carried out by the Construction Industry Research and Information Association (CIRIA) was reported. The process stages are linked by the right kinds of connections and the model responds properly to external stimuli, but assumptions and limitations are inherent in prototype models. Purposes of the study included correcting errors in the computer program and analyzing the sensitivity of the total annual cash flow (TACF) to particular design parameters or cost relationships. The model includes performance relationships, but users must provide cost information. Its results depend totally on the model structure and input data. Influent and effluent quality and various engineering parameters are considered along with TACF. An increase in interest rate or reduction of operating costs shifted the optimal solution away from the use of stages with high capital costs and low operating costs. The lowest number of process units, the maximum volume of individual process units, the cost per unit volume, and the drying-bed area were affected by increasing the model flow incrementally between 0.1 and 0.9 cu m/sec. Several alternative sludge disposal methods, each involving several steps, were compared at various flows. Values considered reasonable for leading design variables were compared with values optimized by the model. It is felt that the model should be developed further, improving performance relationships and economic calculations and adding new processes.

*Cost analysis, *Model studies, *Computers, Engineering, Sewage treatment, Performance, Design criteria

Construction Industry Research and Information Association (CIRIA), Cash flow

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F014
INDUSTRIAL RESEARCH INSTITUTE STUDYING POLLUTION PROBLEMS OF SETO INLAND SEA,

Fukuda, T., and Hayakawa, N.

National Industrial Research Institute of Chugoku,
Kure City,
Hiroshima, Japan.

Civil Engineering in Japan, Vol. 14, p 143-149, 1975. 3 fig.

A scale model was built of the Inland Sea, a shallow, narrow body of water surrounded by three major Japanese islands, to study methods of reducing further water quality deterioration. Its scale ratio is one to 2,000 in the horizontal and one to 160 in the vertical. Tides are reproduced with recirculating pumps and oscillating weirs and measured by up to 40 gauges. A computer is available to aid in the simulation and record the measurements. Over 70 rivers discharging regulated flow of dye solution are included in the model. Water samples can be extracted from any part of the model without disturbing the flow. An ultrasonic current meter measures flow velocity. Cameras are mounted above the model, and can be used to photograph floats. A study of dissolved oil diffusion with this model accurately predicted the results of an incident in which an oil refinery tank burst. Tidal flow in the inland sea is being measured for verification of the model. A more generalized density current basin and an alternating flow channel are used for more fundamental study. Mathematical computer models of tidal flow and diffusion in the Inland Sea are also being developed.

*Water quality, *Model studies, *Water pollution effects, *Mathematical models, Computers, Rivers, Photography, Water pollution control

Japan

F015

COMPUTER-AIDED MODELLING OF STREAM PURIFICATION CAPACITY, PART I: NONLINEAR DO MODEL,

Wang, L. K., Vielkind, D., and Wang, M. H.

Rensselaer Polytechnic Institute,
Troy, New York.

In: Proceedings of the 22nd Annual Technical Meeting of the Institute of Environmental Sciences, April 26-28, 1976, Philadelphia, Pennsylvania, p 553-557. 2 fig, 2 tab, 15 ref.

When non-toxic, biodegradable plant effluent with low nutrient content is released into a stream, the dissolved oxygen (DO) content initially decreases due to the high biochemical oxygen demand (BOD), then increases as the atmospheric aeration rate becomes greater than the BOD, until the normal cycle is reestablished. This process is known as self-purification. Oxygen is needed for the reactions which convert organic substances to carbon dioxide, water, phosphate, sulfate, nitrite, and nitrate. For this reason, a stream is capable of self-purification only if its water contains sufficient DO and necessary microorganisms. The minimum DO concentration is different in different types of streams. Equations exist for calculating the time until the minimum DO content is reached, the DO deficit at that point, the distance to the location where the minimum occurs, and the initial DO deficit. The DO saturation concentration must be known in order to calculate this last quantity. The DO concentration at the critical location must be at least the minimum DO concentration established by governmental standards. A new mathematical model was developed for the DO saturation concentration. A computer was used to compare data with linear, quadradic, and cubic functions of temperature. A cubic function produced the best fit. It was accurate to ± 0.01 mg/liter DO, while a previous model was only accurate to ± 0.1 mg/liter. Results from the model can be used, in turn, to determine DO deficits, the critical DO concentration, and the DO drop that can be allowed in a stream receiving waste water.

*Waste assimilative capacity, *Dissolved oxygen, *Self-purification, *Rivers, *Waste water disposal, Biodegradation, Model studies, Mathematical models, Reaeration, Streams

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F016

COMPUTER-AIDED MODELLING OF STREAM PURIFICATION CAPACITY, PART II: MULTIPLE LINEAR CORRELATION METHOD,

Wang, L. K., Wang, M. H., and Vielkind, D.

Rensselaer Polytechnic Institute,
Troy, New York.

In: Proceedings of the 22nd Annual Technical Meeting of the Institute of Environmental Sciences, April 26-28, 1976, Philadelphia, Pennsylvania, p 558-564. 1 fig, 2 tab, 9 ref.

A FORTRAN computer program can derive two mathematical models for the mechanism of dissolved oxygen exchange by natural waters. The quantities modeled are dissolved oxygen (DO) drop and biochemical oxygen demand (BOD) at the DO sag in a stream. The multiple linear correlation method was previously used to model these quantities. A generally good correlation was demonstrated between DO, BOD, stream water temperature, and stream flow. A computer must be used, however, to develop these models for a specific stream. As an example, these models were developed for a stream which had been studied previously without the computer program. A plant discharged effluent into a small creek which then flowed into the main stream. Data were collected on four days with varying flow conditions. Sampling was performed on the creek both upstream and downstream of the discharge and on the main stream above, at, and below the confluence with the small creek. Data on upstream BOD, stream water temperature, stream flow, and BOD at the stream's sag point were used to obtain the specific models for DO drop and BOD. The observed DO drop at the sag point was predicted very precisely by the specific model. The BOD model showed acceptable accuracy in predicing the loads observed at the sag point.

*Waste assimilative capacity, *Dissolved oxygen, *Self-purification, Streams, Rivers, Reaeration, Waste water disposal, Biodegradation, Model studies, Mathematical models

F017

COMPUTER-AIDED ANALYSIS OF ENVIRONMENTAL DATA, PART II: BIOCHEMICAL OXYGEN DEMAND MODEL,

Wang, L. K., and Wang, M. H.

Rensselaer Polytechnic Institute,
Troy, New York.

In: Proceedings of the 22nd Annual Technical Meeting of the Institute of Environmental Sciences, April 26-28, 1976, Philadelphia, Pennsylvania, p 548-552. 3 fig, 1 tab, 6 ref.

A computer program was developed for the determination of the first-stage biochemical oxygen demand (BOD), the deoxygenation constant, and the correlation coefficient of the BOD mathematical model. BOD is defined as the quantity of oxygen utilized in the biochemical oxidation of organic matter in a specified time at a specified temperature. It is used to measure the concentration of organic pollutants. If an organic waste contains only carbonaceous matter, its ultimate carbonaceous oxygen demand (UOD), also called the first-stage BOD, is a constant. The oxygen needed to oxidize the ammonia formed when organic matter containing nitrogen is oxidized is the nitrogenous oxygen demand (NOD), also called the second-stage BOD. A relatively simple mathematical model for BOD, involving a linear plot, can be used to obtain UOD and the deoxygenation constant and the UOD and determining the correlation coefficient. The first subroutine derives the slope and intercept of the linear plot. Results are given for a set of experimental data used as an example.

*Biochemical oxygen demand, *Model studies, *Mathematical models, Oxygen, Organic compounds, Nitrogen compounds, Computers

Carbonaceous oxygen demand, Nitrogenous oxygen demand

F018

COMPUTER AIDED ANALYSIS OF ENVIRONMENTAL DATA, PART I: LINEAR REGRESSION, PRECISION AND ACCURACY,

Wang, M. H., and Wang, L. K.

New York State Department of
Environmental Conservation,
Albany, New York.

In: Proceedings of the 22nd Annual Technical Meeting of the Institute of Environmental Sciences, April 26-28, Philadelphia, Pennsylvania, p 543-547. 1 fig, 3 tab.

A FORTRAN computer program has been developed which determines the linear regression model, coefficient of correlation, and precision and accuracy of environmental data. The precision and accuracy of a new direct ultraviolet analytical technique were determined. Samples of varying concentrations of cetyldimethylbenzylammonium chloride (CDBAC) in distilled water were analyzed. Graphically, the relationship between CDBAC concentration and absorbance appeared to be linear. The computer method produced a linear regression line independent of the investigator's judgment. This general computer program is suitable for use in analyzing all types of environmental data.

*Analytical techniques, *Computers, Statistical methods, Regression analysis, Ultraviolet radiation, Pollutant identification, Measurement, Chemical wastes

F019
OPTIMAL GROUNDWATER QUALITY MANAGEMENT: WELL INJECTION OF WASTE WATERS,

Willis, R.

Cornell University,
Ithaca, New York,
School of Civil and Environmental Engineering.

Water Resources Research, Vol. 12, No. 1, p 47-53, February, 1976. 2 fig, 3 tab, 25 ref.

A mathematical planning model for optimal use of the quantity and quality resources of unconfined groundwater aquifers is presented. The model assumes discharge of waste water into the system by well injection at a number of predetermined sites. Water quality constraints are maintained at pumping and recharge wells. The aquifer is considered as part of a waste water treatment system including a waste water treatment plant and sources of dilution water. The model minimizes treatment cost while maintaining acceptable water quality levels throughout the aquifer. The model is a steady state representation, with no temporal variations in the hydraulic head, constituent concentrations in the aquifer, pumping rates, or recharge rates. The feasibility of secondary treatment plus dilution water and the assimilation capacity of the aquifer is indicated by the results. Use of the aquifer system may result in significant cost savings. The system allows waste water to be recycled for future use.

*Groundwater, *Aquifers, *Mathematical models, *Injection wells, Water quality control, Model studies, Water management (applied), Waste water treatment

F020
A SIMULATION OF WATER POLLUTION MODEL PARAMETER ESTIMATION,

Kibler, J. F.

In: Proceedings of the 22nd Annual Technical Meeting of the Institute of Environmental Sciences, April 26-28, 1976, Philadelphia, Pennsylvania, p 533-537. 5 ref.

The parameter estimation procedure for a water pollution transport model was developed using simulated data. A two-dimensional instantaneous-release, shear-diffusion model was selected to represent a simple transport process. It was used with a remote sensor model which connected it with an inertial coordinate system. Data from a remote sensor was simulated by values generated by the transport model, with gaussian noise added. A least-squares batch processor used this data to estimate model parameters, providing a means to evaluate sensor characteristics. The most accurate estimates for all parameters could be produced by variable resolution, but variable resolution would increase sensor or data acquisition costs. Data acquisition strategy distinctly affects estimate accuracy. Imaging strategy can be specially designed for accurate estimates of one or two parameters of interest. All parameters can be estimated accurately by multiple data passes. Data acquisition costs can be reduced by using a limited number of carefully placed images, which can yield nearly the accuracy of many more data points.

*Pollutant identification, *Path of pollutants, *Model studies, Water pollution, Mathematical models, Computers

Pollution transport model

F021
SHORT-TERM REGULATION OF BOD UPSETS IN AN ESTUARY,

Jain, R. K., and Denn, M. M.

Delaware University,
Newark,
Department of Chemical Engineering.

Transactions of the ASME: Journal of Dynamic Systems, Measurement, and Control, Vol. 98, No. 1, p 30-31, March, 1976. 1 fig, 5 ref.

Local dynamic regulation at discharge points of effluent biochemical oxygen demand (BOD) upsets in an estuary was studied to determine its feasibility. The study was carried out with a mathematical model for an estuary of constant cross-sectional area, using parameters characteristic of the Delaware estuary. The solution requires the major response to be within the first tidal cycle, but it would be impossible for response to be so rapid in practice. Disturbances die out within approximately 3 days without controls, but averaging extends the period of disturbances to 6 days or more. Thus the spread of poor quality water is increased, although the peak disturbance is considerably reduced. This method of regulation does not appear to be a feasible means of maintaining water quality.

*Water quality control, *Mathematical models, *Biochemical oxygen demand, Estuaries, Waste disposal

F022
A METHOD FOR ASSESSING FRICTION LOSSES FOR A NON-NEWTONIAN FLUID, SUCH AS SEWAGE SLUDGE, UNDER LAMINAR FLOW CONDITIONS,

Selby, A. J.

The Public Health Engineer, Vol. 4, No. 2, p 44-48, March, 1976. 13 fig, 2 ref.

Sewage sludge behaves more like a Non-Newtonian fluid in which shear stress is some function of shear rate, than like a Newtonian fluid. The Generalized Bingham Plastic Equation, which considers the laminar region of Non-Newtonian flow, is used to construct a universal system. This system produces a continuous curve relating friction gradient to flow velocity. It is applied using straight-forward graphical means. To use the method, the relationship between shear stress and shear rate must be determined, requiring rheological testing of the sludge. The density of the sludge must also be determined.

*Hydraulics, *Flow rates, *Sewage sludge, *Mathematical models, Sludge analysis

F023

A NON-LINEAR PROGRAMMING MODEL FOR EVALUATING WATER SUPPLY POLICIES IN THE TEXAS COASTAL ZONE,

Rios, R. A.

Dissertation Abstracts International B, Vol. 36, No. 10, p 5215, April, 1976.

The water supply in Corpus Christi, Texas, could become a constraint on the area's development due to limits of available industrial and municipal supplies. A non-linear model was used for determining the quantity of fresh water needed for future demands and evaluating alternate methods to reduce demand on the primary source. In 1974 the use of the available water resources was less than optimal. Three policies for reducing water demand were studied. These increased fresh water and effluent disposal costs for various groups of users under specific conditions. Uniformly increasing the fresh water cost for all users produced maximum recycle and effluent reuse, resulting in zero discharge of waste water. The total system cost was increased most by this uniform increase. Increasing fresh water cost for industry only produced zero discharge for industrial waste water, but not zero discharge, since no economic incentive for reusing municipal waste water was provided. An effluent tax increasing disposal cost also produced zero discharge for industrial waste water, but reduced municipal demand less than the other policies did. About one-third reduction in total demand could be achieved. These policies would raise waste water treatment and fresh water supply costs considerably, but total costs would still be approximately 1 to 2% of the gross output of the industrial sector in the area.

*Water supply, *Water users, *Municipal water, *Industrial water, *Model studies, Water resources development, Water reuse

Non-linear programming

F024

COMPUTER BASED CONTROL FOR WASTEWATER SYSTEMS,

Gilman, H. D., Ballotti, E. F., and Guarino, C. F.

Greeley and Hansen,
Chicago, Illinois.

Consulting Engineer, Vol. 46, No. 4, p 46-48, April, 1976.

The computer system is becoming an integral element in control of waste water treatment operations as well as monitoring. This has been noted in the upgrading of the water pollution control facilities in Philadelphia. Guidelines are provided for designing procedural models and documenting studies leading to the preparation of detailed specifications. The specifications should define what the supplier is to provide and delineate the information required by the supplier to form an operational data base. Specific computer performance is harder to specify then hardware, requiring significant written and diagrammed information. The information provided must include the types of information to be stored and displayed and the monitoring and control procedures required by the treatment system. The designs for plant monitoring and control are far more critical than data logging and reports, because integrating the computer into a control strategy is inherently a unique procedure. The computer control specification for a subprocess should include the names of all equipment, monitoring and control signals, descriptions of the monitoring and control requirements, control line diagrams, sample cathode ray tube displays, data and formats for printed logs and reports, alarm and status change log statements, storage of cumulative operation hours, process interface requirements, logic diagrams of the required computer operation procedures, and terminology.

*Computers, *Waste water treatment, *Control systems, Automatic control, Model studies, Monitoring

F025

DYNAMIC MODELLING AND CONTROL SIMULATION OF A BIOLOGICAL WASTEWATER TREATMENT PROCESS,

Von Jeszenszky, T., and Dunn, I. J.

Eidgenossische Technische Hochschule Zurich,
Zurich, Switzerland,
Technisch-Chemisches Laboratorium.

Water Research, Vol. 10, No. 5, p 461-467, 1976. 11 fig, 2 tab, 9 ref.

A dynamic control model of a two-stage reactor for biological treatment of waste water was developed. The rate of sludge recycle was manipulated according to exit substrate concentration deviations or entering substrate flow rate and concentration changes. The influence on process control of a Monod model and a linear model, with and without time delay functions, was investigated. The response of the system to sine variations of inlet concentration and flow was simulated by computer. Sludge recycle control provided substantial improvement for all models. On-off feedback control was best for linear models. Feedforward control was more effective for Monod kinetics.

*Model studies, *Biological treatment, *Waste water treatment, Control systems, Recycling, Sludge treatment

Linear model, Monod model

F026

OPTIMAL ALLOCATION OF MEASUREMENT AND CONTROL RESOURCES WITH APPLICATION TO RIVER DEPOLLUTION,

Olgac, N. M., Cooper, C. A., and Longman, R. W.

Columbia University,
New York, New York,
Department of Mechanical Engineering.

IEEE Transactions on Systems, Man, and Cybernetics, Vol. SMC-6, No. 5, p 377-384, May, 1976. 6 fig, 24 ref.

Under suitable circumstances, artificial instream aeration is the preferred abatement method for river pollution. An optimal aeration strategy was developed operating on measurements of dissolved oxygen (DO) and biochemical oxygen demand (BOD). DO measurements, which are relatively inexpensive and essentially instantaneous, were modeled as having no cost or time lag. Constraints in measurement of BOD are contamination by noise, time lag, and expense of collecting data. Partial differential equations describe the relationship between DO, BOD, effluent discharges, and artificial aeration. Without loss of generality, this distributed parameter control problem was transformed into a set of lumped parameter control problems along characteristic lines of the original partial differential equations. A model resulted which is adequate for arbitrary temporal and spatial distributions of effluent discharge and variable river cross sections. This ordinary differential equation model was transformed to a discrete time model because of the inherently discrete nature of the BOD measurements. The model includes uncertainty in the a priori knowledge of effluent source rates and in all water quality measurements. Optimal assignment of valuable efforts between aeration and measurement of BOD was made in terms of this model. This optimal strategy is independent of the measurement values. Numerical calculations were also made indicating how BOD measurements can be best located along a river. The dependence of the optimal measurement strategy upon observation noise variance and time lag were numerically investigated.

F027
MINIMIZATION OF CORE REQUIRED IN ROUTING THROUGH A CHANNEL NETWORK,

Heler, J-J.

Simulation Network Newsletter, Vol. 7, No. 7, p 1-8, October 1, 1975. 16 fig, 2 ref.

A method has been discussed for decreasing the computer core requirement for simulation of channel networks for a simple case of flow routing. Most natural watersheds are arranged in networks, which are arbitrary sets of channels, reservoirs, and diversion points logically connected in a tree structure. The tree structure is divided into reaches which are computational elements receiving inflow and producing outflow. The order of the reaches upstream from a given point does not matter, when using a routing algorithm. For each reach of the network, a routing algorithm assembles the cumulated outflows from all tributaries, computes the local inflows, and computes outflows. Before these computations are made on any reach, they must be made on all of its tributaries. Within this requirement there are several ways to analyze a tree structure, with varying requirements for computer data storage. One such method, 'Theseus traversing', involves starting with the leftmost reach that has no tributaries and proceeding downstream as far as possible, then moving to the next reach to the right with no tributaries and proceeding downstream as far as possible. When the tree structure is properly ordered, this method requires the least computer data storage. The optimum way to order the tributaries is to sort them according to the order. A reach with no tributaries has order 0; a reach with one tributary has order one and other reaches have the same order as their tributary with the highest order or an order higher by one if two tributaries both have the highest order. A formula is given for determining the core requirement in terms of buffers needed to analyze a tree structure with a given number of reaches. These methods are also applicable to quality constitutents and sediment routing, but only in tree structures.

*Analytical techniques, *Computer models, *Data storage and retrieval, *Computers, *Simulation analysis, Channel flow, Routing, Reach (streams)

Tree structures

F028
THE SIMULATION OF SEDIMENT TRANSPORT,

Leytham, K. M.

Simulation Network Newsletter, Vol. 7, No. 8, p 1-8, November 15, 1975. 4 fig, 9 ref.

A deterministic, fixed bed stream sediment transport model has been developed which accepts inputs of water and sediment from the land surface phase as modeled by the Agricultural Runoff Management (ARM) Model. A kinematic wave technique is used to simulate flows in the system. Interchange of suspended material with stream bed material, scour and aggradation, the effect of armoring on scour rates, and longitudinal dispersion due to variations in velocity are the major sediment processes represented. Sediment outflow from a channel reach is first approximated by assuming slug flow but the estimate is later adjusted to allow for longitudinal dispersion and changes in sediment concentration with time. It is assumed that all the sand, some silt, and a small portion of the clay settle out during the modeling interval. Steady state transport rates for cohesionless materials are converted to scour rates by assuming that ultimate steady state concentrations would be achieved by the end of each modeling interval. The model includes additional algorithms for beds containing cohesive clay and silt materials. Armoring, an effect in which immobile, cohesionless particles protect the particles under them from scour, is included in the model. The algorithms for settling and scour are used to calculate a new concentration which, together with the initial concentration assumed for slug flow, is used to calculate the sediment outflow.

*Analytical techniques, *Simulation analysis, *Clays, *Sands, *Silts, Sediments, Mathematical models, Model studies, Runoff, Natural streams, Scour

Sediment transport

F029
EVALUATION OF THE CIRIA PROTOTYPE MODEL FOR THE DESIGN OF SEWAGE-TREATMENT WORKS,

Bowden, K., Gale, R. S., and Wright, D. E.

Water Pollution Control, Vol. 75, No. 2, p 192-205, 1976. 3 fig, 3 tab, 17 ref.

A prototype computer model for the cost optimization of sewage treatment plant design is presented. Performance relationships for each of the unit processes involved are built into the model; cost data are not incorporated into the model since these vary considerably from site to site and with the degree of inflation. Parameters used for characterizing the process are those used in conventional sewage treatment practice (biochemical oxygen demand, suspended solids, ammonia for liquors, and total solids content and volatile content for sludge). Application of the model is illustrated by an example involving a series of sewage works having different flows but the same series of processes and the same influent and effluent concentrations.

*Sewage treatment, *Optimization, *Computer programs, *Model studies, *Cost analysis, Waste treatment, Evaluation

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F030
A PRESENT VALUE-UNIT COST METHODOLOGY FOR EVALUATING WASTEWATER RECLAMATION AND DIRECT REUSE AT A MILITARY BASE OF OPERATIONS,

Ciccone, V. J.

United States Army Mobility Equipment Research and
Development Center,
Fort Belvoir, Virginia,
Sanitary Sciences Division.

December, 1974, 24 p. 1 fig, 16 ref. Report No. 2123.

A present value-unit cost (PVUC) methodology was applied to a water supply problem typical for a military base, considering reclamation and direct reuse of treated waste waters. A hierarchy of water use was established, with the highest quality for potable purposes and a lesser quality for non-potable uses. The difference in the calculated unit costs for the alternatives was examined over selected planning horizons, indicating the practicality of a particular quality scheme in the comparison of alternatives. This difference was included in a FORTRAN mathematical model for use on a digital computer. The model selects an optimal water supply system for a military base. The ideas of a dual supply system are incorporated by the reclamation of treated waste waters and the direct reuse of these waters after specified advance treatment. The focus of the model is on the demand for water and alternative methods to satisfy it. The major emphasis is on the role of cost as a determinant. The model essentially consists of a difference equation between the calculated PVUC for each alternative taken over selected planning horizons. A dual water supply system was concluded to be a practical alternative for consideration. The PVUC was a usable measure for evaluating alternatives, and the calculated difference between the PVUC's of two alternatives yielded a worthwhile decision variable, easily calculated with a computer program. The methodology may be applied to existing systems in conjunction with expansion plans or to formulating plans for new military bases.

F031
CONTRIBUTION TO OPTIMIZING CHEMICAL PRECIPITATION IN UNTREATED WASTE WATER THROUGH CONTROL OF THE ADDED FLOCCULANT QUANTITY (BEITRAG ZUR OPTIMIERUNG CHEMISCHER FAELLUNG IM ROHABWASSER DURCH DIE STEUERUNG DER FAELLMITTELZUGABEMENGE),

Overath, H., and Marr, G.

Gas-und Wasserfach-Wasser/Abwasser, Vol. 117, No. 3, p 109-122, 1976. 15 fig, 5 tab, 42 ref.

The influence of different chemical and physical characteristics of untreated municipal waste water on the optimal dosage of flocculant (a by-product from bleaching earth production, a highly acid liquid with Al, Fe, Ca, Mg and Cl ions) was studied in model experiments. The optimal quantity of the flocculant was determined primarily by the phosphorus concentration in the raw waste water. A correlation factor of 0.963 was found for the relationship between phosphorus concentration and the optimal flocculant dose. The correlation factor expressing the relationship between the optimal flocculant dose and the pH value before the flocculant addition is -0.455. A correlation factor of 0.670 was found for the alkalinity. The correlation with the electric conductivity was found to be 0.818. The findings indicate that the electrical conductivity, the standardized alkalinity and turbidity can be used a parameters for the control of the flocculant dosage.

*Waste water treatment, *Chemical precipitation, *Flocculation, *Optimization, *Phosphorus, Hydrogen ion concentration, Alkalinity, Electrical conductance, Turbidity

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F032
VERIFICATION STUDIES OF THE BIOFILM MODEL FOR BACTERIAL SUBSTRATE UTILIZATION,

Williamson, K., and McCarty, P. L.

Journal Water Pollution Control Federation, Vol. 48, No. 2, p 281-296, February, 1976. 19 fig, 5 tab, 8 ref.

A verification study was performed for a model describing the kinetics of substrate utilization by biofilms. Aerobic, autotrophic, nitrifying bacteria were used as test organisms. Biofilms were made before each experiment by filtering dispersed bacteria onto membrane filters. The biofilm thickness was determined by examining a side view of the biofilm and the support filter with a microscope and a calibrated ocular micrometer. The diffusion reactor consisted of an enclosed Plexiglas cylinder immersed in an outer vessel. The biofilm model accurately predicted the biofilm substrate utilization rate for deep biofilms that are flux and substrate limited by either an electron donor or an electron acceptor. It was also modified to predict accurately the substrate utilization rate for thin biofilms that were flux and substrate limited by the electron donor and for which the substrate concentrations throughout the biofilm were greater than the half-velocity coefficient. A mathematical relationship was determined indicating whether the biofilm will be flux limited by the electron acceptor or the electron donor. Diffusion coefficients for ammonia, nitrate, nitrite, and oxygen through biofilms of nitrifying bacteria of about 80 to 100% of their corresponding values in water were obtained.

*Biological treatment, *Waste water treatment, *Model studies, *Kinetics, *Aerobic bacteria, Membranes, Diffusion, Films

*Biofilms

F033

FREQUENCY DISTRIBUTIONS FOR COLIFORM BACTERIA IN WATER,

Pipes, W. O., Ward, P., and Ahn, S. H.

Drexel University,
Philadelphia, Pennsylvania,
Department of Environmental Engineering.

In: International Conference on Environmental Sensing and Assessment, Vol. 1, September 14-19, 1975, Las Vegas, Nevada, p 4-5-1 - 4-5-5. 4 fig, 1 tab, 7 ref.

Data from multiple fermentation coliform counts on raw water from a water treatment plant were analyzed to determine the best fit statistical frequency distribution. The data for each of five runs fit a negative binomial distribution and did not fit a Poisson distribution which had been assumed to be valid for coliform counts. Thus, the use of the Poisson distribution to represent coliform counts appears to lead to an underestimate of the variability of these counts, and the calculation of the most probable number values from multiple tube fermentation tests leads to underestimates of mean coliform densities.

*Coliforms, *Waste water (pollution), *Statistical models, *Statistical methods, *Fermentation, Evaluation, Measurement, Pollutant identification, Mathematical studies, Water treatment

Bacterial counts, Poisson distribution, Binomial distribution, Multiple tube fermentation tests

F034

AUTOMATED FORECAST PROCEDURES FOR RIVER QUALITY MANAGEMENT,

Dunsmore, D. A., and Boes, R. J.

In: International Conference on Environmental Sensing and Assessment, Vol. 1, September 14-19, 1975, Las Vegas, Nevada, p 14-6-1 - 14-6-5. 2 fig.

A dynamic water quality model designed for use in conjunction with a robot monitor network in the Ohio River Basin is described. The model, which is known as STREAM, is both time and event dependent and operates on the basis of appropriate river geometry definitions in conjunction with waste load discharge data. Depending on the modeling objective, the model may accept any combination of constant or dynamically variable data to model travel time, river temperature, dissolved oxygen, conductivity, and chloride in one of three operational modes available. Additional variables may be modeled by means of optional user exits and a user data bank. A free form of input combined with the availability of a command structured dictionary allows individuals with little computer expertise to operate the model efficiently. The model is being used to supplement water quality management activities throughout the Ohio River and is part of an automated pollution forecasting system.

*Model studies, *Ohio river, *Water quality, *Forecasting, *Automation, Monitoring, Surface waters, Dissolved oxygen, Chlorides, Water management, Rivers, Computer programs

F035

AN INTEGRATED POWER PROCESS MODEL OF WATER USE AND WASTEWATER TREATMENT IN CHLORINE CAUSTIC PRODUCTION,

Singleton, F. D., Jr., Galloway, J. A., and Thompson, R. G.

1975, 87 p, 20 fig, 17 tab, 20 ref, 2 append. Technical Report PB-242 159.

A linear economic model of a representative chlorine-caustic plant was developed and used for evaluating the economic effects of increasingly restrictive waste water effluent standards and higher costs of water withdrawals on production costs, effluent taxes, water use, and solid waste discharges in chlorine-caustic production. Both mercury cell and diaphragm cell production methods were studied at the design stage. The model included production processes, energy system processes, water use and waste water treatment processes, and disposal processes for solid wastes and brine. The least-cost combination of processes was determined for each specification of waste water effluent standards and water withdrawal costs. Each combination of processes gives the quantity of each input purchased, the quantity of each pollutant discharged, and the cost of producing the required amount of chlorine caustic. Incremental cost estimates were made for increasingly restrictive waste water effluent standards for each pollutant. The marginal values implied by each combination were used to develop demand schedules for both the disposal and withdrawal uses of water. Zero discharges of total solids increased production costs 5.6% in diaphragm cell plants and 12.1% in mercury cell plants. Only diaphragm cells can accomplish zero discharge of mercury.

*Waste water treatment, *Model studies, *Water utilization, *Industrial production, *Chemical industry, Costs, Industrial water, Standards, Effluents

Chlorine caustic, Effluent standards

F036

AN EVALUATION OF WATER REUSE FOR MUNICIPAL SUPPLY,

Dworkin, D., and Baumann, D. D.

Butler University,
Indianapolis, Indiana,
Holcomb Research Institute.

December, 1974, 266 p, 31 fig, 33 tab, 6 append. Technical Report 74-11.

A simulation model for evaluating the economic efficiency of water reuse was formulated and applied to Colorado Springs. For a wide range of streamflows and population projections, present reuse practices were compared with an alternative plan providing for reuse only when required. The model demonstrated reuse to be efficient and inexpensive for supplementing municipal water supply, even when the reuse application itself was inefficient. Present practices were not efficient; reuse was provided for many years when reservoirs were oversupplied. The model showed reuse to be unnecessary for much of the planning period even when high population growth was assumed. The simulations used flows based on a synthetic 100 year record of flows. Three 50-year segments were selected from this record so that the most severe conditions of low flows would occur during the later period of the simulation when water use was highest. They indicated that Colorado Springs has more water than engineering estimates of yield indicate. Reuse should be considered as a standby source to be used only when water supply probably will be delayed; postponing use of conventional sources may result in loss of water rights under Colorado law. Use of an alternative plan would require integrated planning. In general, a water renovation program should not be undertaken when potable water reservoirs are oversupplied. When reservoirs are no longer oversupplied and levels decrease, renovated water should be supplied to users who are indifferent to using it. As water requiremens increase, restrictions on the use of potable water or other encouragement to use renovated water may be needed.

F037

MODELING SOLUTE TRANSPORT IN GROUND WATER,

Konikow, L. F.

Denver Federal Center,
Denver, Colorado,
U. S. Geological Survey.

In: International Conference on Environmental Sensing and Assessment, Vol. 2, September 14-19, 1975, Las Vegas, Nevada, p 20-3-1 - 20-3-6. 7 fig, 18 ref.

A computer model for simulating solute transport in flowing groundwater was developed by coupling a finite-difference solution to a groundwater flow equation with the solution to a solute-transport equation using the method of characteristics. The model accurately reproduced the observed 30-year history of contamination at the Rocky Mountain Arsenal in Colorado where liquid industrial wastes seeped out of unlined disposal ponds and spread for many square miles in an underlying alluvial aquifer. The model also integrated the effects of several factors that controlled changes in chloride concentrations. The model can thus predict the rates and directions of the spreading of conservative contaminants from known or projected sources when adequate hydrogeologic data are available.

*Model studies, *Groundwater, *Path of pollutants, *Solutes, *Industrial wastes, *Flow, Ponds, Aquifers, Chlorides, Computer programs

Solute transport, Disposal ponds

F038

AN IMPROVED MODEL FOR ANALYSIS OF AIR AND WATER POLLUTION DATA,

Mage, D. T., and Ott, W. R.

Environmental Protection Agency,
Las Vegas, Nevada,
Office of Research and Development.

In: International Conference on Environmental Sensing and Assessment, Vol. 2, September 14-19, 1975, Las Vegas, Nevada, p 20-5-1 - 20-5-5. 5 fig, 2 tab, 13 ref.

The role of univariate probability models in environmental data analysis is discussed, and an improved model for the analysis of air and water pollution data is presented. The improved model is based on a 3-parameter lognormal distribution and is proposed by considering diffusion processes, including sources and sinks, as stochastic phenomena. When the third parameter is negative, the model is censored at the third parameter; and when the third parameter is zero, a standard 2-parameter lognormal model results. The model was examined for 9 sets of water quality data obtained from the Ohio River including biochemical oxygen demand, chemical oxygen demand, coliforms, chloride, and sulfate. It showed considerable improvement over a standard 2-parameter lognormal distribution when parameters were estimated by the method of maximum likelihood. The model is recommended for general purpose analyses of environmental data.

*Model studies, *Water pollution effects, *Statistical models, *Mathematical models, *Diffusion, Ohio river, Rivers, Biochemical oxygen demand, Chemical oxygen demand, Coliforms, Chlorides, Sulfates, Analytical techniques

Data analysis

F039

PHOSPHORUS TRANSPORT IN A PACKED BED REACTOR,

Overman, A. R., Chu, R-L., and Leseman, W. G.

Florida University,
Gainesville,
Agricultural Engineering Department.

Journal Water Pollution Control Federation, Vol. 48, No. 5, p 880-888, May, 1976. 11 fig, 11 ref.

A dispersed flow model of phosphorus transport in a packed bed reactor (soil) was developed to gain information on the fate of this nutrient in advanced waste treatment processes handling municipal waste water. The model adequately described both transient response and steady-state distributions and showed that the processes of dispersion, convection, chemical reaction, and adsorption are relevant to transport. Transport coefficients of dispersion, reaction, and adsorption were found sensitive to pore velocity (flow rate); this apparently was due to the treatment of a heterogeneous reactor as an equivalent homogeneous reactor for the purpose of providing a transport equation amenable to mathematical solution. The usefulness of the model is not particularly limited by this approximation. Phosphorus measurements from a field under irrigation with municipal waste water (fixed bed reactor) exhibited a steady-state distribution which closely agreed with that of the laboratory model (packed bed reactor).

*Packed beds, *Model studies, *Tertiary treatment, *Waste water treatment, *Phosphorus, Chemical reactions, Dispersion, Adsorption, Convection, Flow rates, Municipal wastes, Irrigation, Mathematical models

Fixed bed reactors

F040

COMPUTER AIDED PLANNING OF A REGIONAL DISPOSAL SYSTEM FOR MUNICIPAL SLUDGE,

Allan, F. J., Silveston, P. L., Keay, W. L., and
Simonen, E. R.

In: Annual Conference Proceedings of the Ontario Section of the American Water Works Association, Pollution Control Association of Ontario, and Ontario Municipal Water Association, April 20-23, 1975, Toronto, Ontario, p 115-135. 10 fig, 4 tab.

A computer program for planning the regional disposal of municipal sludge is described. The program is capable of searching numerous alternatives which exist between the two extremes of a centralized facility serving all sludge sources and a decentralized disposal system with a disposal system for each sludge source. The computer program divides sludge disposal planning into three interacting sub-problems: facility planning, allocation of sludge to the facilities, and sludge transport planning. The planner submits several locations and types of facilities to the computer which searches for the most economic system. A user training manual which provides information on data sources and set-up procedures is also available.

*Sludge disposal, *Computer programs, *Cost analysis, *Regional analysis, Municipal wastes, Waste disposal, Treatment facilities, Planning, Economics, Regional development

F041

PHYSICAL AND SETTLING CHARACTERISTICS OF PARTICULATES IN STORM AND SANITARY WASTEWATERS,

Dalrymple, R. J., Hodd, S. L., and Morin, D. C.

American Public Works Association,
Chicago, Illinois.

April, 1975. 32 p. 14 fig, 8 tab, 31 ref, 3 append. Technical Report PB-242 001.

As a part of model studies on a swirl primary separator and a helical combined sewer overflow regulator, artificial materials whose settling velocity characteristics are similar to those of raw sanitary sewage flows and combined sewer overflows were studied. A literature search provided little information on the settling velocities of suspended matter on combined sewer overflows. Sanitary sewage, combined sewer overflow, and stormwater were sampled and their settling characteristics determined. The median settling velocity of suspended solids in primary sewage was 0.054 cm/sec. The settling velocities of all the artificial materials studied were higher than this value. The artificial material with the lowest settling velocity was an anion exchange resin, Amberlite IRA-93. To lower its settling velocity, the resin was pulverized and sieved. The portion between 74 and 149 microns closely simulated the settling characteristics of sewage. The IRA-93 is of uniform density and apparently reacts according to Stokes' law for spherical particles. Arizona Road Dust, between 10 and 20 micron, also had the desired settling velocity, but is expensive and reportedly unavailable. Therefore, the IRA-93 was selected for use.

*Waste water treatment, *Sewerage, *Analytical Techniques, *Hydraulic models, *Combined sewers, Waste treatment, Regulated flow, Overflow, Water quality, Particle size, Density, Settling velocity

Solids separation, Overflow quality, Particulate density

F042

A COMPUTER BASED OPERATIONAL STRATEGY FOR THE JOINT TREATMENT OF MUNICIPAL AND INDUSTRIAL WASTEWATERS,

Andrews, J. F., and Olsson, G.

In: 3rd National Conference on Complete WateReuse, June 27-30, 1976, Cincinnati, Ohio, p 60-64. 2 fig.

A computer-based strategy for the combined treatment of municipal and industrial waste water is described which overcomes problems associated with the detrimental effects of certain industrial wastes on biological treatment processes. The basis of the strategy is the scheduling of batch dumps of industrial wastes so that they arrive at the treatment plant relatively unmixed with other waste water. This can be accomplished by real-time computer simulations using a dynamic model of the sewerage system. The discharge of batch industrial wastes to municipal sewers are timed in such a manner that their transport to combined treatment plants occurs when the municipal waste water flow rate is at its lowest. Upon arrival at the treatment plant, the mixture of waste waters can be diverted to a variable volume holding tank and then, depending on the characteristics of the industrial waste, be bled into the biological process over the full 24-hour period or treated by physical and/or chemical processes prior to discharge into the biological process for further treatment.

*Waste water treatment, *Industrial wastes, *Municipal wastes, *Computer programs, *Model studies, *Simulation analysis, Treatment facilities, Biological treatment, Control systems

Municipal-industrial wastes

F043

HOW TO DESIGN AERATED LAGOON SYSTEMS TO MEET 1977 EFFLUENT STANDARDS - EVALUATION OF KINETIC COEFFICIENTS,

Rich, L. G., and White, S. C.

Clemson University,
Environmental Systems Engineering.

Water and Sewage Works, Vol. 123, No. 6, p 90-92, June, 1976. 5 fig.

Laboratory techniques and mathematical methods for estimating kinetic coefficients associated with the design of aerated lagoon systems are described. Retention time and power input are cited as the two main features of lagoon design. The selection of the former is based on a knowledge of which retention time provides the best solids removal with sedimentation for a particular waste and on the rate of soluble organic removal. The selection of power input is based on the amount of oxygen needed for respiration and biological conversion of the waste water and on the mixing requirements. Laboratory equipment and calculation procedures are illustrated for estimating changes in respiration rates and soluble biochemical oxygen demand, dissolved oxygen depletion rates, substrate removal rates, and respiration coefficients.

*Oxidation lagoons, *Aeration, *Waste water treatment, *Kinetics, *Mathematical studies, Dissolved oxygen, Biochemical oxygen demand, Organic compounds, Suspended solids, Biological treatment, Equipment, Design criteria

F044

ESTIMATING THE RELIABILITY OF ADVANCED WASTE TREATMENT,

Dean, R. B., and Forsythe, S. L.

Environmental Protection Agency

Water and Sewage Works, Vol. 123, No. 6, p 87-89, June, 1976. 4 fig, 2 tab.

Statistical methods for estimating the reliability of advanced waste water treatment plants are discussed. Since the usual measurements of pollutants in waste water are lognormally distributed, plotting the data as a normal distribution is not appropriate and the plotting of cumulative probability distributions on log-probability paper becomes necessary. If a population can be fitted by a log-normal distribution, predictions about future performance can be made with a high degree of confidence provided that the process is in statistical control (variations appear to result from consistent causes). Data on phosphate levels are taken from an advanced waste water treatment plant and are plotted normally and as their logarithms. The latter case produces a straight line, with a median value of 0.]9 milligrams/liter and a spread factor of 2.1. The median is a good estimate of the geometric mean.

*Statistical methods, *Reliability, *Tertiary treatment, *Waste water treatment, *Water quality, Phosphates, Mathematical studies, Evaluation, Performance, Treatment facilities

F045
COMPUTER HALTS FLOODING COMPLAINTS,

Anderson, D. J., and Meyers, R. O.

Watermation, Incorporated,
St. Paul, Minnesota.

Water and Wastes Engineering, Vol. 13, No. 6, p 27-28, 30, 32, 62, June, 1976. 4 fig.

The use of a computerized mathematical model to analyze flooding problems and raw sewage overflow has resulted in a cost savings amounting to two-thirds that of replacing the sewer system for the city of Lakewood, Ohio. The mathematical model used to analyze the city's sewer system involved three routines. One routine calculated the amount of rainfall which enters the sewers from the streets, rooftops, and grassed areas; and a second routine determined the amount of flow lost to the environment at various regulators in the system. A third routine computed the travel time for a given flow rate to traverse a pipe from the upstream to the downstream end. The alternative solution to sewer system replacement selected as a result of the computerized analysis involved the installation of 10 new control regulators to reduce combined sewer overflow at a cost of about $24.3 million.

*Sewers, *Overflow, *Mathematical models, *Flooding, *Computer programs, *Combined sewers, Analytical techniques, Costs, Economics

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F046
VALUE ENGINEERING: MAKE SURE THE COSTS ARE RIGHT,

Wexler, H. M.

Minges Associates,
Farmington, Connecticut.

Water and Waste Engineering, Vol. 13, No. 6, p 34-36, 38, 49, June 1976. 5 fig.

Value engineering, a systematic approach to achieve cost savings without sacrifice of benefits, is discussed in relation to sewage treatment plants. The objective of value engineering for sewage treatment plants is to minimize life-cycle costs which consist of the initial construction costs of the facility as well as maintenance, operation, and replacement costs. It is imperative that a formal value engineering program be initiated as early as possible, especially before important design concepts such as secondary treatment processes, tertiary filtration methods, types of lift stations, mode of building and process heating, and piping and materials are finalized. An example of the application of value engineering to the upgrading of a waste water treatment serving a population of about 20,000 is presented and reveals that in this particular case the abandonment of existing trickling filters in favor of rotating biological contactors results in up to a 50% savings in electrical energy consumption and more consistent performance.

*Cost-benefit analysis, *Costs, *Benefits, *Economics, *Waste water treatment, *Treatment facilities, Construction costs, Maintenance costs, Operating costs, Replacement costs

*Value engineering

F047
ANALYSIS OF REGIONAL WASTE TREATMENT SYSTEMS,

Weeter, D. W., and Belardi, J. G.

Tennessee University,
Knoxville,
Department of Civil Engineering.

Journal of the Environmental Engineering Division-ASCE, Vol. 102, No. EE1, p 233-237, February, 1976. 7 ref, 1 append.

A technique had previously been developed to screen the large number of possible alternatives in the regional waste water treatment plant optimization problem. The problem involves a system of sources, each of which may be connected to any other source or treat its own sewage. The initial technique involves first determining the least-cost disposal alternative for the waste water at each source. If it is most economical for each of two systems to pipe waste water to the other, the decision with the least overall cost is determined. The amounts of waste water to be treated at each source are then determined. If these amounts have changed, the process begins again with determining the least-cost alternatives. This technique was unsuccessful for some systems of sources. Suggested improvements include checking for different disposal decisions rather than different amounts of waste water to be treated. The procedure for resolving contradictory decisions could also be simplified. The original technique will occasionally miss the optimal solution, but this problem could be corrected by checking 'the sources adjacent to those treating'. A mechanism should also be added to halt the procedure if a nonconverging system is detected. The method of accumulating waste water flows was also revamped. The amount of manual calculation required could be reduced by determining the waste water accumulating at each source based on current disposal decisions as the first step. The ability to handle systems in which cycling is possible was also added to the original technique. Another modification makes it possible to handle systems in which not all sources are possible sites for treatment plants.

*Waste water treatment, *Sewage treatment, *Sewerage, *Analytical techniques, *Treatment facilities, Regional analysis, Regional economics, Alterantive planning, Optimization

Regional waste treatment

F048
DENSE EFFLUENT DISPERSION IN A STREAM,

Crew, H., and Reid, R. O.

Oregon State University,
Corvallis,
School of Oceanography.

Journal of the Engineering Mechanics Division-ASCE, Vol. 102, No. EM1, p 77-88, February, 1976. 7 fig, 4 ref, 2 append.

The dispersion of a dense effluent continuously injected upwards through a circular port into a stream of uniform velocity and density was studied. Far field dispersion of the effluent was modeled numerically and the results compared with analytical solutions of the linearized equations. The model is designed to single out the influence of gravity on dispersion, rather than simulate dispersion in a natural stream. Several simplifying assumptions, such as the absence of shear in the ambient stream, have been made. In most respects, numerical solutions for low effluent density anomaly agree closely with analytical solutions of the linearized equations in the bounded domain. Although the analytical solutions are inappropriate for highly dense effluent, since they neglect the effects of nonlinear advective transport, the numerical solutions for high density effluents appear to be physically realistic extensions of the low density solutions. The numerical solutions also conserve mass and exhibit theoretically expected energy tendencies. The numerical results seem to be satisfactory solutions of the governing equations and boundary conditions for a broad range of effluent densities.

*Analytical techniques, *Density, *Effluents, *Dispersion, *Streams, Outlets, Velocity, Mathematical models, Mixing, Model studies

F049

SHOOTING MODELS FOR SALINITY AND COLIFORM,

Olufeagba, B. J., and Flake, R. H.

Texas University,
Austin,
Department of Electrical Engineering.

Journal of the Environmental Engineering Division-ASCE, Vol. 102, p 95-109, February, 1976. 9 fig, 2 tab, 14 ref.

A technique that employs multiple shooting methods to solve the boundary value equations for two water quality variables, salinity and coliform contamination, in New York's Jamaica Bay is described. The method reformulates a two dimensional dispersion problem over a system of disjoint subsets of the estuary topography such that the problem is reduced to a multipoint boundary value problem relative to a system of local spatial coordinate directions. A numerical algorithm based on multiple shooting and employing a linear four-step integrator for ordinary differential equations is used to evaluate the solution to the decomposed problem. The method is shown to give a very accurate representation as demonstrated by the negligible computational error in net mass flow of conservative material (10 to the minus 16th power pounds/second) out of the bay. Results of actual water quality models for salinity and coliform single constituent configurations are presented.

*Mathematical models, *Bays, *Model studies, *Salinity, *Coliforms, Estuaries, Water quality, Bacteria, Microorganisms, Pollutants, Surface waters, New York

Jamaica Bay

F050

MODELS FOR EVALUATION OF HAZARDOUS WASTES,

Klee, A. J.

Environmental Protection Agency,
Cincinnati, Ohio,
Municipal Environmental Research Laboratory.

Journal of the Environmental Engineering Division-ASCE, Vol. 102, p 111-125, February, 1976. 8 tab, 14 ref.

An additive utility model for evaluating a set of hazardous waste streams is described. The steps required for developing and using the model include: the selection of criteria (attributes of waste streams upon which the evaluations are to be based), the performance of basic measurements on each criterion for each waste stream, the assignment of within-criteria hazard ratings across waste streams by the use of a lottery procedure, the determination of the values of the relative utility ranges by the use of a ratio procedure, consistency checks of the relative utility ranges, and multiplication of the within-criteria hazard ratings by the relative utility ranges to obtain the overall hazard rating for each waste stream. An examination of several proposed hazardous waste rating model is also presented.

*Waste water, *Mathematical models, *Model studies, *Toxicity, *Water quality, Water pollution, Hazards, Statistical methods, Evaluation

F051

LAND-USE MODEL FOR SERVICE AREA PROJECTION,

Meier, P. M.

Brookhaven National Laboratory,
Upton, New York,
Department of Applied Sciences.

Journal of the Environmental Engineering Division-ASCE, Vol. 102, p 71-85, February, 1976. 8 fig, 18 ref.

A mathematical land use model for predicting area sewer service needs is presented. The model is developed on the premise that the prediction of the spatial distribution of population is fundamental to a prediction of sewer service areas. A significant advantage of the model over traditional expedients is its ability to make rational and quantitative predictions of the effect of particular policy assumptions. For example, the effect of increasing or decreasing the requisite marginal density for service area extension may be tested by manipulation of a single input parameter. The model is limited in that it focuses on the urban periphery and cannot be used at the detailed design level. The results of the model appear to be particularly suited to the sizing of waste water treatment plant or water supply facilities and major interceptors as well as the evaluation of tradeoffs between the scale economies of regional facilities and interconnecting interceptors.

*Mathematical models, *Sewers, *Land use, *Planning, *Regional analysis, Waste water treatment, Water supply, Treatment facilities, Interceptor sewers, Economics

F052

SOLUTION FOR RADIAL-FLOW WITH NONLINEAR ADSORPTION,

Gupta, S. P., and Greenkorn, R. A..

Amoco Production Company,
Tulsa, Oklahoma.

Journal of the Environmental Engineering Division-ASCE, Vol. 102, p 87-94, February, 1976. 2 fig, 14 ref.

A dispersion model for radial flow with nonlinear adsorption is formulated using the Freundlich isotherm. The numerical method used for solving the model is the Crank-Nicolson technique in which the nonlinear coefficients are approximated by a forward projection of coefficients at the half level in time. Solutions are reported for the movement of chemicals in a homogeneous porous medium from a point source, and these solutions are of practical importance to the discharge of pollutants where an adsorbing material disperses radially. The model can be used to study possible spatial and temporal movements of chemicals from contaminated water in soils.

*Dispersion, *Mathematical models, *Soil water movement, *Adsorption, *Flow characteristics, Chemical wastes, Pollutants, Model studies, Groundwater

F053

TWO-DIMENSIONAL MATHEMATICAL WATER QUALITY MODEL,

Williams, B. J., and Hinwood, J. B.

Melbourne University,
Melbourne, Australia,
Centre for Environmental Studies.

Journal of the Environmental Engineering Division-ASCE, Vol. 102, No. EE1, p 149-163, February, 1976. 5 fig, 1 tab, 24 ref, 2 append.

Hydrodynamics and physical and chemical pollutant quantities carried by water were modeled for Westernport Bay, near Melbourne, Australia. Topographic, hydrodynamic, pollutant transport, chemical kinetics and interaction models are interconnected, with the output of one used as input for another. Values of dissolved oxygen deficit; organic carbon; biochemical oxygen demand (BOD); nitrogen as organic matter, nitrate, and ammonia; coliforms; conservative pollutants; suspended solids; and bulk water temperature are provided. The models were tested and some calibration and verification tests were conducted. Model and field measurements agreed within the uncertainty of the data. No data were available to check the chemical kinetics and interaction model, and, barring a major spill, are unlikely to be.

*Pollutant identification, *Analytical techniques, *Biochemical oxygen demand, *Water quality, *Mathematical models, Path of pollutants, Model studies, Hydrodynamics, Australia, Bays

Westernport Bay (Australia)

F054

LARGE-SCALE ESTUARINE WATER QUALITY MATRIX MODEL,

Penumalli, B. R., Flake, R. H., and Fruh, E. G.

Texas University,
Austin,
Department of Electrical Engineering.

Journal of the Environmental Engineering Division-ASCE, Vol. 102, No. EE1, p 191-209, February, 1976. 8 fig, 5 tab, 16 ref, 3 append.

A mathematical water quality model (TRANS) utilizing an efficient computational algorithm was developed for two-dimensional vertically mixed estuaries. It has a simple structure ideally suited to optimization techniques for water quality management studies. A mean square error criterion was established for calibrating the model and an error analysis method developed for judging the accuracy of the numerical solution. The modeling approach was applied to Corpus Christi Bay, Texas, utilizing field data for total phosphorus. The large dimension matrix equation obtained was efficiently solved by a new error correction algorithm. This algorithm was found to achieve faster convergence than two well-known methods for solving large matrix equations. The water quality results were compared with those of another model (POTRAN) solved under identical conditions for Corpus Christi Bay. TRANS required only about half the computation time and approximately two-thirds the memory of POTRAN.

*Pollutant identification, *Analytical techniques, *Estuaries, *Water quality, *Mathematical models, Model studies, Algorithms, Mixing, Optimization, Calibrations

Matrices

F055

TWO-DIMENSIONAL WATER QUALITY MODELING AND WASTE TREATMENT OPTIMIZATION FOR WIDE, SHALLOW RIVERS,

Eheart, J. W.

Dissertation Abstracts International B, Vol. 36, No. 12, p 6300-6301, June, 1976.

A mathematical model was developed for two-dimensional steady-state dissolved oxygen and biochemical oxygen demand (BOD) distribution from the discharge of treated sewage into a wide, shallow river. The results produced by the model were compared with the results of simpler models in a hypothetical case. The implications of the assumptions upon which the simpler models are based are discussed. The model was tested with field data and found to be slightly more accurate than a variation of the model which assumes the channel to be prismatic, and much more accurate than a simpler model assuming a rectangular channel with plug flow. The clearlane was defined as a means to specify standards for ambient water quality. The model and linear programming were used in determining the optimal strategy for sewage treatment for a hypothetical river basin with specified clearlane standards. The dependence of the optimal strategy on the clearlane location was investigated.

*Waste water treatment, *Sewage treatment, *Severage, *Analytical techniques, *Biochemical oxygen demand, Water quality, Mathematical models, Waste treatment, Optimization, Rivers

F056

STATISTICAL STUDY OF PHOSPHORUS REMOVAL IN WISCONSIN,

David, M. H., Schroeder, F. J., Peirce, J. J., Joeres, E. F., and Braasch, D. A.

Wisconsin University,
Madison.

Journal of the Environmental Engineering Division-ASCE, Vol. 102, No. EE2, p 433-447, April, 1976. 1 fig, 6 tab, 7 ref, 2 append.

In 1974, Wisconsin required phosphorus effluent to be limited to one mg/liter. Actual phosphorus removal began at different times in different municipalities. Phosphorus is usually removed by adding chemicals to augment biological uptake and settling of phosphorus from waste water. Data were gathered from 12 municipalities for two years, including the compliance deadline. A simple statistical model was developed explaining the effluent water quality. A variation of the model showed no significant interaction between treatment and flow in excess of the design capacity. Adding iron compounds did not significantly reduce phosphorus, possibly due to incorrect dosages or dosage points, but did increase the sludge volume. Reducing effluent phosphorus was not directly attributable to using a polymer with treatment chemicals; enhancement of chemical effectiveness cannot be ruled out, since no information on polymer dosage was included. Sludge volume increased with polymers. Treatment for phosphorus did not produce secondary water quality benefits; effluent biochemical oxygen demand (BOD) was not significantly changed. These combined findings imply that some communities nominally attempting to reduce effluent phosphorus do not achieve significant reduction from the levels achieved by conventional secondary treatment. Effective treatment throughout the Wisconsin portion of the Lake Michigan Basin requires effective monitoring, counseling, and legal proceedings.

*Waste water treatment, *Biological treatment, *Biochemical oxygen demand, *Phosphorus, *Wisconsin, Effluents, Cities, Statistical models

F057

ANALYTICAL THREE-DIMENSIONAL TRANSIENT MODELING OF EFFLUENT DISCHARGES,

Yeh, G-T., and Tsai, Y-J.

Stone and Webster Engineering Corporation,
Boston, Massachusetts.

Water Resources Research, Vol. 12, No. 3, p 533-540, June, 1976. 10 fig, 19 ref.

A transient, three-dimensional turbulent diffusion equation describing the distribution of a substance or heat in a time-dependent flow field is solved analytically. Two models are considered, both dealing with tidal-affected riverine water bodies and the vicinity of rather straight coastlines or island lines. One treats both the depth and the width of a water body as being finite, while the other deals with finite depth but with infinite width. The method of Green's function is utilized in searching for solutions. For practical applications the velocity is assumed to be the sum of a harmonic component and a constant. No limitations exist on the type of source conditions. The model is capable of simulating both the space and the time variation of dye concentrations in tidal water bodies. These models should remove the need for using numerical models in many situations.

*Pollutant identification, *Analytical techniques, *Model studies, *Effluents, *Discharge (water), Diffusion, Turbulence, Equations, Distribution, Heat

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F058

POPULATION BALANCE USE IN DILUTE IMPURITY PROBLEMS,

Stevens, J. D., and Schierholz, P. M.

Iowa State University,
Ames,
Department of Chemical Engineering and
Nuclear Engineering.

Journal of the Environmental Engineering Division-ASCE, Vol. 102, No. EE2, p 337-346, April, 1976. 4 fig, 5 ref, 2 append.

The population balance for chemical processes and its applications are introduced. In systems in which precipitation occurs, a population balance permits the characterization of crystal size distribution (CSD) in terms of the birth rate (nucleation), the growth rate, and, if applicable, the death rate. The population balance states that the number of discrete particles must be conserved, and if birth, death, and flow rates are properly represented then all particles can be accounted for. An equation providing a functional relationship between size and population density is derived from the population balance. The technique for obtaining kinetic models for nucleation and growth rate is illustrated. Application of the techniques in a study of the precipitation of calcium carbonate when solutions of calcium sulfate and sodium carbonate are mixed in a continuous crystallizer is described. The analytical approach is useful for processes involving sludge return. The population balance analysis approach is applicable to many environmental situations in which a dilute amount of solute is removed by crystallization. The CSD can be used to derive kinetic relationships used to predict effects of operating changes on the process.

*Waste water treatment, *Analytical techniques, *Chemical precipitation, *Particle size, *Nucleation, Growth rates, Flow rates, Equations, Model studies, Calcium compounds, Crystallization

F059

OPTIMAL ACTIVATED SLUDGE DESIGN UNDER UNCERTAINTY,

Tarrer, A. R., Grady, C. P. L., Jr., Lim, H. C., and
Koppel, L. B.

Auburn University,
Auburn, Alabama,
Department of Chemical Engineering.

Journal of the Environmental Engineering Division-ASCE, Vol. 102, No. EE3, p 657-673, June, 1976. 2 fig, 5 tab, 28 ref, 2 append.

A computer program was developed which allows optimization of the liquid treatment process train of the activated sludge process while incorporating practical constraints and an effluent quality goal and allowing for parameter uncertainty. Application of the program to a typical domestic sewage situation resulted in a very conservative design, particularly with respect to liquid-solid separation. The inclusion of a model for the clarification function of the final settler strongly influenced the optimum design. The mean cell residence time for rapidly degraded waste waters must be constrained during optimization to insure that it is sufficiently high to allow adequate liquid-solid separation. Changes in mean cell residence time significantly affect the sizes of the individual operations in the process train but have little effect on the total treatment cost. Changes in the sizes of the optimum designs' unit operations produced by changes in thickening characteristics can be counter-intuitive. During treatability studies, equal emphasis should be placed on the characterization of liquid-solid separation parameters and parameters of biological kinetics. When extreme values are used for all parameters, conservative designs are achieved. Waste strength greatly affects treatment cost. For a given waste, if the process is not pushed past reasonable limits, treatment cost is relatively insensitive to the degree of treatment.

*Waste water treatment, *Sewage treatment, *Biological treatment, *Activated sludge, *Sewerage, Analytical techniques, Treatment facilities, Design

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F060

FLOW APPROACHING FILTER WASHWATER TROUGHS,

French, J. A.

Camp Dresser and McKee, Incorporated,
Boston, Massachusetts.

Journal of the Boston Society of Civil Engineers Section American Society of Civil Engineers, Vol. 62, No. 4, p 139-160, January, 1976. 8 fig, 1 tab, 12 ref.

A potential flow model is used to study the flow of backwash water (laden with filtered solids) in its progress from the top of the filter bed to the washwater troughs above the filter. For a given trough spacing, the round-bottom trough that minimizes the region of nonuniform flow above a filter bed is one with an external total width equal to 0.25 times the center-to-center spacing and with a total external draft equal to 0.20 times the center-to-center spacing. This design also promotes more efficient flushing of floc particles from the filter. Diminution of the nonuniform flow region and more efficient flushing can also be promoted by decreasing the trough spacing, but there are practical lower limits to trough spacing. Paths and travel times of fluid elements and suspended particles are investigated for the above optimal trough design and two alternative designs.

*Filtration, *Mathematical models, *Flow, *Filters, *Hydraulics, *Design criteria, Separation techniques, Waste water treatment, Performance, Evaluation, Suspended solids

Filter backwashing, Backwashing

F061

EQUALIZATION OF TIME VARIABLE WASTE LOADS,

Novotny, V., and Stein, R. M.

Marquette University,
Milwaukee, Wisconsin,
Civil Engineering.

Journal of the Environmental Engineering Division-ASCE, p 613-625, June, 1976. 7 fig, 2 tab, 16 ref.

A mathematical model describing influent variability removal in waste water treatment systems is presented. Input-output relationships for completely mixed basins, dispersed flow basins, and plug flow basins are developed using time-series analysis and transformation in the frequency domain. The models describe equalization of concentration or waste load fluctuations assuming linear systems with first-order decay. Model-derived design formulas for purely random and harmonic inputs are obtained, assuming completely mixed treatment systems. The model approach is demonstrated and verified by an evaluation of the performance of two dispersion flow equalization basins and completely mixed laboratory units. The evaluation results indicate good agreement between measured and computed equalization characteristics.

*Waste water treatment, *Model studies, *Mathematical models, *Flow, *Unsteady flow, Flow characteristics, Equalizing reservoirs, Hydraulic structures, Hydraulic transients, Hydraulics, Analytical techniques

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F062

CLOSED LOOP HIERARCHICAL CONTROL FOR RIVER POLLUTION,

Singh, M. G., and Hassan, M.

St. John's College,
Cambridge, England,
Laboratoire d'Automatique et d'Analyse des
Systems du C.N.R.S.

Automatica, Vol. 12, No. 3, p 261-264, May, 1976. 3 fig, 3 tab, 11 ref.

A feedback solution is obtained for a two-polluter river pollution control problem using a hierarchial method. The hierarchial optimization algorithm uses continuous time No Delay, Pure Delay, and Distributed Delay models of the Cam River near Cambridge. All of the calculations are done off-line within a decentralized computational structure. The resulting constant gains provide optimal feedback control for any initial condition, and this control can be implemented on-line. The method is also demonstrated on a three-polluter Distributed Delay model. Various simulation studies on river pollution problems associated with biochemical oxygen demand and dissolved oxygen show the efficacy of the method for river pollution control.

*Water pollution control, *Rivers, *Mathematical models, Biochemical oxygen demand, Dissolved oxygen, Water quality control, Surface waters, Simulation analysis

F063
COMPUTER EVALUATION OF SLUDGE HANDLING AND DISPOSAL COSTS,

Smith, R., and Eilers, R. G.

Environmental Protection Agency,
Cincinnati, Ohio.

In: Proceedings of the 1975 National Conference on Municipal Sludge Management and Disposal, August 18-20, 1975, Anaheim, California, p 30-59. 13 fig, 6 tab, 20 ref.

A digital computer program which is capable of examining the cost and performance of a wide variety of alternative sludge handling schemes for municipal waste water treatment plants is described. The basic computational program is known as the Executive program and contains a subroutine for each of the liquid and sludge treatment alternatives. It also contains rate and mass balance relationships necessary to generate the effluent stream vectors when one or more influent stream vectors are supplied together with certain decision variables. The subroutine sizes all structures and equipment and estimates the capital, operating, and maintenance costs associated with the process. The capability of the program is demonstrated for 261 alternative sludge treatment and disposal schemes. The program is designed to be used as a management tool to narrow the range of sludge treatment and disposal options when the site-specific conditions are known.

*Sludge treatment, *Sludge disposal, *Computer programs, *Municipal wastes, *Cost-benefit analysis, Management, Programs, Performance, Evaluation, Treatment facilities, Waste water treatment

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F064
DESTRUCTION OF ALKALINITY IN AEROBIC BIOLOGICAL WASTEWATER TREATMENT,

Sherrard, J. H.

Virginia Polytechnic Institute and State University,
Blacksburg,
Department of Civil Engineering.

Journal Water Pollution Control Federation, Vol. 48, No. 7, p 1834-1839, July, 1976. 1 fig, 5 tab, 5 ref.

A mathematical model is used in conjunction with biochemical stoichiometric equations to describe alkalinity destruction which occurs in nitrifying activated sludge waste water treatment systems. The model results reveal that the commonly accepted value of 7.14 pounds of alkalinity as calcium carbonate destroyed/pound of ammonia-nitrogen oxidized is in error. The error is primarily due to the incorporation of ammonia-nitrogen into the heterotrophic biomass. As a result, a smaller quantity of ammonia-nitrogen is available to be oxidized to nitrate-nitrogen. Primary factors affecting alkalinity destruction in nitrifying activated sludge systems are the influent waste water biochemical oxygen demand:nitrogen:phosphorus ratio and the net microorganism specific growth rate. An example problem is presented to illustrate the importance of these two factors in calculating alkalinity destruction.

*Nitrification, *Activated sludge, *Alkalinity, *Waste water treatment, *Mathematical models, Ammonia, Nitrogen, Nitrates, Nitrogen fixing bacteria, Biological treatment, Biochemical oxygen demand, Phosphorus, Growth rates, Calcium carbonate, Chemical reactions

F065
WATER TEMPERATURE SIMULATION,

Lum, G. T.

Simulation Network Newsletter, Vol. 8, No. 3, 8 p, May, 1976. 5 fig, 2 tab.

The methodology of water temperature simulation is reviewed and applied to a case study. Simulation of water temperature is based on the use of an artificial control volume. Changes in the heat content of the control volume are due to internal sources, internal sinks, or transport of the heat across control volume boundaries. The general methodology is to evaluate each individual effect, then sum the effects to arrive at the net overall change in heat content of the control volume. Temperature simulation of river systems is greatly simplified by the absence of internal sources and sinks of heat. Changes in the heat content are due only to the transport process of advection, diffusion and dispersion, and heat transfer across the water surface. The representation of advected heat is easily done if the model contains flow-routing procedures. The accurate representation of diffusion and dispersion involves several complications; however, these two parameters can be assumed negligible relative to advection. Transport of heat across the air-water interface involves a number of different mechanisms which cannot be predicted adequately. The usefulness of water temperature simulation is illustrated by evaluating the effects of a proposed nuclear power plant on the downstream thermal regime of the Columbia River System.

*Simulation analysis, *Water temperature, *Heat transfer, *Water pollution effects, *Rivers, Model studies, Columbia river, Mathematical models, Advection, Methodology, Nuclear power plants

F066
THE NONPOINT SOURCE POLLUTANT LOADING (NPS) MODEL,

Litwin, Y. J., and Sonigian, A. S., Jr.

Simulation Network Newsletter, Vol. 8, No. 4, 4 p, July, 1976. 4 fig, 4 ref.

A computerized model for simulating nonpoint source pollutant loading is described. The model continuously simulates the hydrologic processes, including pollutant accumulation, generation, and washoff from the land surface as well as snow accumulation and melt. The model is limited in the sense that only land surface contributions to nonpoint source pollution are evaluated. Subsurface and groundwater pollutants as well as channel processes are not considered. The model is concerned with the total loading or pollutant input to a stream channel or waterbody from the land surface; for water quality evaluations in watersheds where in-stream processes are significant, the model must be interfaced with stream water quality models. Sample results of simulating overland flow quantity and quality for an urban watershed are presented and indicate that the model provides a viable means for assessing land surface contributions of nonpoint pollutants. Calibration of certain model parameters is a necessary and critical step when applying the model to a particular watershed since the model is limited by simplifications due to incomplete descriptions of the processes controlling nonpoint pollution.

*Computer models, *Overland flow, *Water pollution sources, *Simulation analysis, *Surface runoff, Urban runoff, Surface waters, Model studies, Watershed management

Nonpoint pollution

F067
REVERSE OSMOSIS AS AN ADVANCED TREATMENT PROCESS,

Lim, H. S., and Johnston, H. K.

Journal Water Pollution Control Federation, Vol. 48, No. 7, p 1804-1821, July, 1976.
8 fig, 8 tab, 5 ref.

Bench-scale and pilot plant studies of the effectiveness of reverse osmosis in removing nutrients and residual chemical additives from waste water were conducted. Reverse osmosis proved capable of removing nutrients from raw waste water, secondary waste water and non-waste water. Phosphate removals approaching 100% were attained. Ammonia removals averaged 85%, and nitrate and nitrite rejections of approximately 56% were observed. Chemical additives conventionally used as phosphorus precipitating agents were almost completely removed. Aluminum, iron, and sulfate ion removals were above 97%; and calcium and chloride removals were 92% and 83%, respectively. During 4 months of operation, the removal efficiencies of all solutes studied remained almost constant. Variability in operating conditions exerted little effect on membrane selectivity, although permeate flux varied considerably. Surface fouling was most pronounced for membranes that exhibited lower rejection abilities.

*Reverse osmosis, *Tertiary treatment, *Waste water treatment, *Nutrients, *Additives, Pilot plants, Efficiencies, Phosphates, Ammonia, Nitrates, Nitrites, Aluminum, Iron, Sulfates, Calcium, Chlorides, Membranes, Fouling

H001

QUALITY ASSURANCE FOR GROUNDWATER,

Environmental Science and Technology, Vol. 10, No. 3, March, 1976. 2 fig.

As of August 1975, about 100 million Americans were dependent upon underground sources of drinking water. Recently, underground injection of waste water and other means by which groundwater may become polluted have become a matter of concern. The Safe Drinking Water Act of 1974 (PL 92-523), signed into law in December 1974, provides for the establishment of state programs for protection of underground potable water sources. Under the drinking water law, the EPA administrator designates which states must design groundwater quality control programs. It was mandated that by 180 days after the enactment of PL 92-523, the EPA administrator must have published proposed regulations for state underground injection control programs and that promulgation of these regulations was to have occurred by the next 180 days. As of the beginning of 1976, the regulations are still in the proposed stage. Sources for potential groundwater contamination include brines from secondary and tertiary oil recovery, industrial waste injection wells, petrochemical operations wastes, and leachates from sanitary landfills. Injection wells must be monitored by the states or in the absence of a satisfactory state program, the EPA will monitor. In addition to the control of groundwater pollution by the EPA, the World Health Organization Collaborating Committee on Surface and Ground Water Quality is developing the following on an international basis: uniform methods for monitoring water quality; uniform analytical instruments; and, uniform data storage and retrieval systems.

*Water quality control, *Groundwater, *Water supply, *Potable water, Groundwater resources, Water pollution sources, Monitoring, Legislation

Safe Drinking Water Act of 1974, World Health Organization Collaborating Committee on Surface and Ground Water Quality

H002

POLLUTION OF GROUNDWATER BY LANDFILLS (POLLUTION DE L'EAU SOUTERRAINE PAR LES DECHARGES),

Matthess, G.

Techniques et Sciences Municipales--L'Eau, No. 2, p 67-75, 1976. 18 refs.

The possibilities for minimizing hazards of groundwater pollution, as related to choice of landfill site, are discussed. Some hydrogeological conditions are mentioned in which local groundwater pollution can be tolerated to avoid other environmental hazards. In hydrogeological conditions unfavorable to landfill siting, such as karst, heavily fractured rock, and aquifers, where the porosity allows for a high flow rate, landfills should be authorized only where widespread pollution of groundwater is prevented.

*Groundwater, *Landfills, *Water pollution control, Hydrological aspects, Flow rates

H003

PERCOLATION TESTS FOR SEPTIC TANK SUITABILITY IN SOUTHERN ARIZONA SOILS,

Barbarick, K. A., Warrick, A. W., and Post, D. F.

University of Arizona,
Tuscon,
Department of Soils, Water, and Engineering.

Journal of Soil and Water Conservation, Vol. 31, No. 3, p 110-112, May-June, 1976.
2 fig, 4 tab, 20 ref.

Percolation tests for septic tank suitability were conducted in nine southern Arizona soils to determine relationships between the percolation rate and test-hole diameter and to correlate the rates with selected soil parameters. Both a mathematical relationship and a regression analysis were used to relate percolation rate to test-hole geometry. Percent carbonates varied from 1.6% to 7.4%, pH from 7.7 to 8.1, electrical conductivity from 0.1 to 0.4, and EDTA required for the saturation extract from 0.2 ml to 0.7 ml. The theoretically predicted percolation rate of a 10 cm diameter test-hole was 2.5 times that of a 30 cm hole, an estimate which approximated the experimental results. Variability coefficients for percolation rates at each site ranged between 7% and 48%. Percent sand, clay, and silt in the subsoil correlated significantly with percolation rate. Multiple regression analysis showed that percentages of clay, silt, sand, gravel, and carbonates in subsoil; subsoil pH and electrical conductivity; and amount of EDTA required accounted for 62% of the variation in percolation rates. A variance analysis of soil parameters indicated significant differences among the sites for every parameter.

*Percolation, *Soil tests, *Septic tanks, *Testing procedures, *On-site tests, *Soil properties, Subsoil, Sands, Clays, Silts, Gravels, Soil types, Soil chemistry, Hydrogen ion concentration, Electrical conductance

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H004

THE FATE OF POLLUTANTS IN SUBSURFACE ENVIRONMENTS,

Metry, A. A.

In: 22nd Annual Technical Meeting of the Institute of Environmental Sciences, April, 1976, Philadelphia, Pennsylvania, p 1-5. 8 fig.

Degradation of subsurface water quality is widespread. Examples of the pollution of groundwater due to improper land disposal are cited. Subsurface water can also be polluted by waste water seepage, deep well injection, and leachates from hazardous solid wastes. The threat to subsurface water in a given area is indicated by its hydrogeologic parameters, which should be important in planning storage and disposal sites. Mathematical models are developed to predict the migration and fate of leachate and pollutants in subsurface environments. A one-dimensional mathematical model was developed for attenuation of pollutants in subsaturated soils. Several mathematical models are developed for the migration of pollutants from a disposal site into aquifers; all include molecular diffusion, convective dispersion, and chemical reaction. A computer program simulating pollutant fate in aquifers was developed, incorporating the output of the subsaturated soils model and predicting concentrations of pollutants at various points in the aquifer. The models are flexible and practical, and account for the major mass transport mechanisms. They can be used in disposal site selection, evaluation of environmental impact, and recovery of groundwater contaminants. Their accuracy depends on that of the hydrogeologic parameterss used in the simulation.

*Subsurface waters, *Aquifers, *Aquifer management, *Mathematical models, *Groundwater, *Waste disposal, Hydrogeology, Hydrologic data, Computer programs, Model studies, Mathematical models

H005
DEVELOPMENT OF A METHODOLOGY FOR MONITORING
GROUNDWATER QUALITY,

Todd, D. K., and Everett, L. G.

In: International Conference on Environmental Sensing and Assessment, Vol. 1, September 14-19, 1975, Las Vegas, Nevada, p 9-3-1 - 9-3-4.

A chronological procedure for implementing a groundwater quality monitoring program is presented. The approach is general so that it can be applied in a local area under a variety of land use and hydrogeologic conditions. The implementation procedure consists of the following steps: selection of the area or basin to be monitored, definition of groundwater usage, identification of pollution sources and causes, definition of the hydrogeologic situation, studies of existing groundwater quality, prioritization of pollution sources and causes, evaluation of existing monitoring programs, identification of alternative monitoring approaches, selection and implementation of the monitoring program, review and interpretation of the monitoring results, and summarization and transmittal of monitoring information.

*Monitoring, *Groundwater, *Water quality, *Pollutant identification, Data collections, Programs, Network design, Measurement

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H006
MONITORING GROUNDWATER POLLUTION,

Schmidt, K. D.

In: International Conference on Environmental Sensing and Assessment, Vol. 1, September 14-19, 1975, Las Vegas, Nevada, p 9-4-1 - 9-4-6. 25 ref.

Procedures for the monitoring of groundwater pollution are outlined. Groundwater pollution monitoring entails source monitoring, evaluation of infiltration potential, monitoring in the topsoil and vadose zone, and aquifer monitoring. The most important aspect of groundwater pollution monitoring is in water well sampling. If existing wells are not sufficient, specially designed monitoring wells may have to be constructed. Source monitoring also includes inventorying and sampling solid and liquid wastes which may eventually percolate to the water table. Waste disposal methods partly determine infiltration potential and whether or not portions of the soil-groundwater system are being bypassed. In general, major inorganic constituents are the most mobile in soil-groundwater systems, and bacteriological pollutants are the least mobile. Time trends and the three-dimensional distribution of groundwater quality must be evaluated to successfully monitor aquifer pollution.

*Groundwater, *Monitoring, *Wells, *Aquifers, *Soils, Infiltration, Groundwater movement, Infiltration rates, Soil water movement, Soil properties, Water quality, Pollutant identification, Bacteria, Inorganic compounds, Subsurface waters, Sampling, Percolation, Water table

H007
MANAGEMENT OF GROUNDWATER QUALITY DATA,

Hampton, N. F.

Commonwealth Associates, Incorporated,
Jackson, Michigan.

In: International Conference on Environmental Sensing and Assessment, Vol. 1, September 14-19, 1975, Las Vegas, Nevada, p 9-5-1 - 9-5-5. 1 tab, 5 ref.

Elements necessary for the efficient management of a groundwater quality data base are outlined. A comprehensive groundwater management information system must be capable of maintaining the following types of data: station descriptions, water quality criteria, geologic information, hydrologic information, water quality parameter identifiers, water quality measurements, temporal information, information qualification data, monitoring agency status data, and information indexing. Primary factors considered in selecting data collection systems are purchase and operating cost, reliability, responsiveness, and minimizing bottlenecks created by relatively high internal computer processing speeds and low input speeds. User access to groundwater surveillance data should be in the batch mode, whereas access to the information index system component should be in the real-time mode. The development of the data storage component of the system entails the selection of hardware devices, data organization schemes, and data base management software packages. Computerized data processing is accomplished either in batches or on a real-time basis. Real-time processing should be implemented only where rapid system response is needed since batch processing permits more efficient hardware utilization. The data retrieval component of a groundwater data file must yield both alphanumeric and pictorial output.

*Groundwater, *Water quality, *Data collections, *Computer programs, *Data storage and retrieval, Data processing, Computers, Subsurface waters

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H008
GROUNDWATER POLLUTION MONITORING CASE STUDIES,

Wilson, L. G.

Arizona University,
Tucson,
Water Resources Research Center.

In: International Conference on Environmental Sensing and Assessment, Vol. 1, September 14-19, 1975, Las Vegas, Nevada, p 9-6-1 - 9-6-4. 20 ref.

Recommendations for groundwater pollution monitoring based on five case studies of aquifer contamination are presented. The following procedures are recommended: establish an interdisciplinary committee at the outset to ensure collection of interrelated quality parameters; examine the hydrogeology of the problem site; ensure that the sampling well network is as dense as possible in the vicinity of the pollution source; use alternative techniques in addition to wells for defining the confines of the pollution plume; establish a thorough regular sampling program in wells and surface water supplies; analyze samples not only for major constituents but also for heavy metals, organic toxins, and microbial concentrations; use tracers for defining the flow of pollution; use predictive computer models of the flow system; monitor in the zone of aeration as well as in the saturated zone, particularly when the former is of considerable thickness and when perching layers may develop; develop innovative or specialized monitoring techniques when necessary; and continue monitoring until the problem has been quantified.

*Monitoring, *Groundwater, *Aquifers, *Sampling, *Wells, Pollutant identification, Heavy metals, Organic compounds, Microorganisms, Subsurface waters, Groundwater flow, Tracers, Hydrogeology, Computer models

H009
GROUNDWATER SUPPLIES OF THE COASTAL REGION,

LeGrand, H. E.

In: Proceedings of the Southeastern Conference on Water Supply and Wastewater in Coastal Areas, April 2-4, 1975, Wilmington, North Carolina, University of North Carolina, p 87-101. 3 fig, 16 ref.

Problems associated with the quality and availability of groundwater supplies along the east coast are reviewed. Groundwater suitable for domestic water supplies occurs at shallow depths throughout the coastal region, though pollution from septic tanks and other sources of manmade pollution is becoming a serious problem in developed areas. The tertiary limestone aquifer along the east coast is one of the most productive aquifers in the world; however, concentrated pumping in certain areas is causing salt water encroachment of this artesian source. Salt-water encroachment in artesian sand aquifers is not yet a serious problem, but excessive concentrated withdrawal of groundwater from these sources may lead to serious salt water problems in the future. A groundwater management policy involving the salvaging of water discharged naturally into the sea and estuaries, the selective dispersion of centers of well water withdrawal, and the careful management of waste disposal practices is recommended.

*Water supply, *Groundwater resources, *Saline water intrusion, *Aquifers, *Coasts, Water pollution effects, Water management (applied), Wells, Septic tanks

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H010
DEEP WELL DISPOSAL OF WASTEWATER,

Crooks, J. W., and Sever, C. W.

Environmental Protection Agency,
Atlanta, Georgia,
Hydrogeology Section.

In: Proceedings of the Southeastern Conference on Water Supply and Wastewater in Coastal Areas, April 2-4, 1975, Wilmington, North Carolina, University of North Carolina, p 68-74. 3 ref.

The use of deep-well injection for the disposal of waste water and the preservation of usable groundwater supplies is discussed. The use of deep injection wells for the storage of treated waste water in salt water aquifers can in some cases provide a twofold benefit: potentially harmful viruses and bacteria that might survive secondary treatment are removed from man's environment; and the injected fresh waste water displaces a poorer quality (salty) groundwater, thus creating a new reserve of usable water in underground storage. Along many coastal areas in particular, the heavy withdrawal of potable groundwater from fresh-water aquifers is causing salt water encroachment inland into the aquifer systems; and, in such cases, treated waste water may be injected into the aquifer system to create a hydraulic barrier and hold back the encroaching salt water. Regulations of the Safe Drinking Water Act which deal with the protection of groundwater from the injection of wastes into the ground are reviewed along with Environmental Protection Agency policies on water reuse.

*Waste water disposal, *Coasts, *Water reuse, *Deep wells, *Injection wells, *Aquifers, Water distribution (applied), Water management (applied), Water conservation, Viruses, Bacteria, Waste water treatment, Legislation, Regulation

Safe Drinking Water Act

377

H011

URBAN DRAINAGE - PROBLEMS AND POSSIBILITIES,

Waller, D. H.

Nova Scotia Technical College,
Halifax, Nova Scotia, Canada,
Civil Engineering Department.

In: Annual Conference Proceedings of the Ontario Section of the American Water Works Association, Pollution Control Association of Ontario, and Ontario Municipal Water Association, April 20-23, 1975, Toronto, Ontario, p 136-153. 3 tab, 17 ref.

Problems associated with urban drainage are reviewed along with some proposed solutions. Changes in ground cover and surface topography that occur as a result of urban development are associated with a drop in groundwater level, decreased stream flows during dry weather, and increased soil erosion which results in surface water turbidity and sediment accumulation in lakes, storage basins, and sewage plants. Drainage problems associated with already developed urban areas include those associated with overloaded drainage systems and pollution problems due to combined sewer overflows, urban surface runoff, and municipal and industrial effluents. Solutions proposed for such problems include: careful land development which takes advantage of natural storage, combined sewer separation, source and collection system controls, storage systems which are capable of holding wet flow for treatment following storm periods, and treatment systems that are designed to handle wet weather flows. The value of using urban drainage system models for solving the above problems is also discussed.

*Drainage water, *Drainage systems, *Urban drainage, *Urban runoff, *Soil erosion, Sewers, Surface waters, Groundwater, Turbidity, Water pollution effects, Land use, Land development, Sediment load, Effluents, Industrial wastes, Municipal wastes

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H012

POLLUTION EFFECTS ON SURFACE WATERS AND GROUND WATERS,

Terry, R. D., and Hughes, G. M.

Ministry of the Environment,
Toronto, Ontario, Canada.

Journal Water Pollution Control Federation, Vol. 48, No. 6, p 1420-1433, June, 1976. 141 ref.

A literature review on the effects of pollution on surface water and groundwater is presented. General topics covered include: trace metal contamination, the occurrence of herbicides and pesticides in aquatic organisms, nutrient abundance, the effects of land use and industrial operations on water pollution, studies of basin and river pollution, and water quality models and indices. Specific subjects discussed under the above general headings include: the contamination of fish with ethylmercury from industrial waste water; measurements of chlorinated hydrocarbon and polychlorinated biphenyl levels in water, bed material, and fish; the effects of municipal and industrial waste inputs on algal growth and water chemistry; measurements of biochemical oxygen demand loadings for watersheds representing agricultural, urban, and wooded lands; the occurrence of elevated chloride levels in ground and surface waters as a result of oil field brine disposal; the introduction of industrial pollutants to the Danube River; the water quality status of the Potomac River basin; and a review of deficiencies in the application of river quality models.

*Water pollution effects, *Surface waters, *Groundwater, *Chemical wastes, Herbicides, Pesticides, Fish, Municipal wastes, Industrial wastes, Biochemical oxygen demand, Chlorides, Rivers, Basins, Model studies, Metals, Mercury, Polychlorinated biphenyls, Chlorinated hydrocarbon pesticides, Nutrients, Algae, Land use

Ethyl mercury

H013

EFFECTS OF SEWAGE SLUDGE OR EFFLUENT APPLICATION TO SOIL ON THE MOVEMENT OF NITROGEN, PHOSPHORUS, SOLUBLE SALTS AND TRACE ELEMENTS TO GROUNDWATERS,

Page, A. L., and Pratt, P. F.

California University,
Riverside,
Department of Soil Science and
Agricultural Engineering.

In: Proceedings of the 1975 National Conference on Municipal Sludge Management and Disposal, August 18-20, 1975, Anaheim, California, p 179-187. 1 fig, 38 ref.

The movement of nitrogen, soluble salts, phosphorus, and trace elements through soils is discussed in terms of the chemistry of these individual constituents and in relation to low and high rate applications of sludges and effluents and soil properties. When considering the movement of these substances through soils, it is important to distinguish between low rates consistent with utilization for crop production and high rates that might be used for disposal of sludges and effluents or for groundwater recharge using reclaimed waters. At low rates of 3 to 5 tons dry solids per acre per yr to supply the phosphorus needs of crops or 10 to 25 dry tons per acre per yr to supply their nitrogen needs, downward movement of phosphorus and most trace elements is nil or very slow. Soluble salts and nitrate move with drainage waters. At rates of 3 to 5 surface feet of effluent waters per year to supply water needs for irrigated lands, phosphorus and trace elements added will not move downward to any great extent in most soils. Inert sands and gravels of low organic matter contents have low adsorptive capacities and allow rapid transmission of water. Water also generally moves more slowly in soils of higher clay content. Soils other than sands have a high capacity to retain arsenic, cadmium, chromium, copper, mercury, molybdenum, nickel, lead, selenium, and zinc. Where sludges of effluents are added to agricultural soils to supplement plant nutrients or as a source of irrigation water, essentially all of these trace elements applied should remain within the surface meter of soil. In groundwater recharge or disposal involving high application rates, movement of trace elements will depend on the amount and composition of the waters applied and the nature of the soil or sediment.

*Pollutant identification, *Sewage sludge, *Effluents, *Land use, *Soil water movement

H014

IMPACT OF LAND DISPOSAL OF SLUDGES ON GROUNDWATER,

Wilson, G. R.

Geraghty and Miller,
Port Washington, New York.

In: Proceedings of the 1975 National Conference on Municipal Sludge Management and Disposal, August 18-20, 1975, Anaheim, California, p 193-199. 5 fig, 2 tab, 16 ref.

The many problems involved in evaluating the impact of land disposal of sludges on groundwater quality are discussed, with particular emphasis on the hydrologic aspects. The purpose of the discussion is to direct attention to the complexity of the subject, and to suggest some practical considerations that may be applied in evaluating potential disposal sites. The factors governing the chemical and transport behavior of contaminants through the zone of aeration and in the aquifer are enormously complex. At present there appears to be little prospect of any accurate prediction of them prior to the emplacement of sludge, or any other potential contaminant source. This situation may be rectified by theoretical and laboratory studies and by data from field investigations. It is possible to draw up guidelines for land disposal of both sludge and effluent, and this has been done by numerous agencies. These guidelines, however, cannot be definitive. Each proposed disposal site must be studied and evaluated individually.

*Pollutant identification, *Sludge disposal, *Land use, *Groundwater, *Water quality, Hydrologic aspects, Evaluation, Sites

H015

MUNICIPAL WATERSHED MANAGEMENT SURVEY,

Dissmeyer, C. E., and Swank, W. T.

American Water Works Association Journal, Vol. 68, No. 2, p 97-100, February, 1976.
10 tab, 5 ref.

A general summary of survey data on the nature and extent of land uses, management problems, and information needs for municipal watersheds in the southeastern United States is presented, with particular emphasis on small and heavily forested watersheds. Currently, more than half of the small forested watersheds are either totally or partially closed to use. On the remaining watersheds that are open, recreational activities are predominant, with some timber-management activities also being conducted. Major problem areas in watershed management include water quality problems and problems associated with water quantity and seasonal distribution of streamflow. The first problem was reported by 41% of the watershed managers surveyed, and the latter two problems were reported by 22% and 28%, respectively, of the managers surveyed. Information on the effects of forest management activities on the quantity and timing of streamflow does not appear to be reaching water supply managers despite its availability. Additional research is needed to more clearly define the impact of forest practices on water quality.

*Watershed management, *Land use, *Water quality, *Forest management, *Streamflow, Southeast U.S., Recreation facilities, Information exchange, Municipal wastes, Surface waters, Surveys

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H016

WASTEWATER RECLAMATION PROJECT, ST. CROIX, U.S. VIRGIN ISLANDS,

Buros, O. K.

Black, Crow and Eidsness, Inc.
Gainesville, Florida.

June, 1976. 259 p, 43 fig, 7 tab, 29 ref, 1 append. Technical Report EPA-600/2-76-134.

A portion of the flow normally discharged to the sea from St. Croix's primary treatment plant was used for reclamation purposes. It was first processed in an advanced waste water treatment plant (AWWTP) by biological and physiochemical means. The treated waste water was conveyed by a force main to recharge areas located about 1 1/4 mi away. Here it was stored in a holding tank and introduced into the groundwater aquifers by spray irrigation and spreading basins. The project was for the purpose of improving the yield of wells and assisting in preventing further seawater intrusion of a major well field. Background data on water quality and quantity in the area was collected for 2 1/2 yr before recharging began. Recharging was carried out for 8 mo. The best recharging method proved to be with spreading basins in an alluvial valley. The cost for treatment, recharging, and recovery was estimated at about $2.15/thousand gal at 0.5 mgd, the rate used in the study. The project demonstrated that it is possible to economically augment the island's freshwater reserves through using reclaimed waste water to artificially recharge groundwater. There was evidence of a notable increase in available groundwater in the vicinity of the recharge activities. The major problems included lack of sufficient waste water for treatment and recharge, mechanical failure of treatment equipment, and transfer to the central treatment plant of waste water containing a high percentage of sea water. Artificial groundwater recharge can only be accomplished successfully at carefully selected areas on St. Croix. The recharging activities did not significantly affect the water quality of pumped wells.

*Waste water treatment, *Biological treatment, *Treatment facilities, *Waste treatment, *Groundwater recharge, Reclamation, Reclaimed water, Water reuse

J001

STUDY ON THE BALANCE OF HEAVY METALS IN ACTIVATED SLUDGE TREATMENT PROCESS (Gesui shori shisetsu ni okeru jukinzokurui no shushi ni kansuru kenkyu),

Saito, K., Ochi, S., Kobori, K., and Yagihashi, I.

Kankocho Kogai Senmon Shiryo, Vol. 11, No. 1, p 86-118, January, 1976. 32 fig, 35 tab, 27 ref.

A study was conducted between 1972 and 1974 to investigate the effects of low concentrations of heavy metals on a sewage treatment plant in terms of the overall treatment efficiency, and the growth and decomposition rates of activated sludge. The accumulation of heavy metals into the sludge and the loading balance of heavy metals in the treatment process were also determined. Laboratory scale activated sludge units of the continuous and plug flow types were operated. The heavy metals added to the sewage were Cd, Pb, Hg, Ni, Cu, Zn, and Cr in the forms of $CdSO_4$, $Pb(NO_3)_2$, $HgCl_2$, $Ni(NO_3)_2$, $Cu(NO_3)_2$, $ZnSO_4$, and $K_2Cr_2O_7$. The critical concentration at which the inhibition occurred was one to ten Cd mg/liter, 10 mg Pb/liter and 0.005 to one mg Hg/liter. An increase in suspended solids in the effluent was symptomatic of the inhibition. Sludge production increased as the heavy metal concentration in the influent increased within the range of the experiment. Bacteria became dominant while the protozoa population decreased, indicating that one of the causes of increased sludge production is a change in the steps of the food chain due to the heavy metal addition.

*Heavy metals, *Sludge treatment, *Activated sludge, *Waste water treatment, Bacteria, Protozoa, Pollutant identification

Microbial populations

J002

EXPERIMENTAL REPORT FOR REGENERATION OF ACTIVATED CARBON AND RECALCINATION OF LIME SLUDGE (Kasseitan, sekkai-oden no saisei jikken hokoku),

Hirose, F., Kataoka, T., and Kato, T.

Gesuido Kyokaishi, Vol. 12, No. 139, p 26-36, December, 1975. 8 fig, 12 tab, 9 ref.

The regeneration of activated carbon by a six stage regeneration furnace is described, and the recalcination of lime sludge by the same furnace is also considered. The regeneration furnace consisted of three processes: drying, roasting, and activation. The effects of the furnace temperature, regeneration time, and furnace atmosphere on the carbon and lime regenerations were studied. For carbon regeneration, an adsorption capability of 99 to 110% for iodine, phenol, DBS, and Tartrazine (MW 5498) could be obtained when the used carbon was regenerated at 850 C for 30 minutes with a total steam injection rate of about 30 kg/hr and a carbon input rate of 25 to 28 kg/sq m/hr. No decrease in the hardness of the carbon was observed by the regeneration treatment. The yield for the regeneration was more than 97% based on weight. The recovery efficiency of the pore characteristics was high, with a 91 to 101% recovery of both the pore surface area and the pore capacity being obtained. For lime sludge recalcination, 95% conversion from calcium carbonate to calcium oxide could be achieved at a temperature above 850 C for a recalcination time longer than 50 minutes.

*Activated carbon, Lime, Waste water treatment

*Regeneration, Lime sludge recalcination, Regeneration furnace

J003
RECENT TRENDS OF PROCESS CONTROL FOR WATER WORKS AND DRAINAGE (Jogesuido purosesu seigyo no doko),

Bannai, E., Sumi, T., Matsuoka, T., and Kuwayama, K.

Toshiba Rebyu, Vol. 31, No. 1, p 5-8, January, 1976. 5 fig, 1 tab, 2 ref.

To cope with a rapid increase in demand for water and increased pollution of natural waters, recent trends in Japan have included the development and regional utilization of water resources for water works, the expansion of facilities, the collective processing in river basin scales, and the reuse of processed sewage. A major problem is the utilization of such resources as dams, rivers, and the sea. New technology is being developed in regional monitoring systems. A description is provided of those control systems developed by Toshiba, including computer control and instrumentation control.

*Monitoring, *Water pollution control, Regional planning, Waste water treatment, Sewage treatment, Water reuse, Automatic control, Computers, Water works, Water supply

Japan

J004
COMPUTER CONTROL OF SEWAGE AND RAIN WATER PUMPS AT SEWAGE TREATMENT PLANT (Gesuishorijo no osui, amamizu ponpu no keisanki seigyo),

Shinnai, K., Machida, M., and Negoro, Y.

Toshiba Rebyu, Vol. 31, No. 1, p 27-29, January, 1976. 3 fig, 1 tab, 3 ref.

A new computer control method for sewage and rain water pumps in a sewage treatment plant is detailed. The sewage and rain water pumps are similar in that pump well level must be controlled. However, sewage is pumped into an activated sludge process facility, while rain water is pumped into receiving waters. A harmonious, rational and simple control method for the two types of pumps is described.

*Sewage treatment, *Pumps, *Rain water, *Sewage, Control systems, Computers

J005
DISCHARGE OF TREATED WASTE WATER IN LAKES (DIE EINLEITUNG VON GEREINIGTEM ABWASSER IN SEEN),

Buhrer, H., and Ambuhl, H.

Schweizerische Zeitschrift fuer Hydrologie, Vol. 32, No. 2, p 347-369, 1975.
9 fig, 11 tab, 5 ref.

A study was conducted to find the optimum means of discharging treated waste water into a lake. Paths of waste water discharged into a lake were traced four times. Waste water was marked with aluminum powder and the cloud in the lake was registered by an echo-sounder. One measurement was made at the beginning of the overturn period, the rest were taken during the stagnation period. It was found that if there is a steady current in the lake, the waste water drifts, in the form of a plume. If the lake is calm, it accumulates as a cloud at the pipe's mouth and can well up to the depth of bathing. To avoid such an accumulation, currents must be known. A discharge site should be placed only where currents are steady. Based on events measured at Lake Constance, the mixing of one part of waste water with five parts of lake water should be enough to limit the vertical movement to two meters.

*Waste disposal, *Lakes, Waste dilution, Mixing, Paths of pollutants, Discharge (water), Outfall sewers, Outlets, Ultimate disposal

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J006
PERSISTENCE OF FECAL COLIFORM INDICATOR BACTERIA ON ALFALFA IRRIGATED WITH MUNICIPAL SEWAGE LAGOON EFFLUENT,

Bell, R. G.

Agriculture Canada,
Lethbridge, Alberta, Canada,
Research Station.

Journal of Environmental Quality, Vol. 5, No. 1, p 39-42, January/March, 1976.
3 tab, 13 ref.

A study to determine the survival time of fecal coliforms on alfalfa fertilized with sewage was undertaken. Alfalfa in a test plot was irrigated with sewage, and the populations of fecal coliforms found in the alfalfa samples were determined in the laboratory. Ten hours of bright sunlight completely destroyed the fecal coliforms. Their numbers did not decrease under damp, cool, overcast conditions. If sewage treatment failures occurred while sewage effluent was being used to irrigate alfalfa, two sunny days between irrigation and consumption of forage would adequately protect livestock from possible infection.

*Coliforms, *Fertilization, *Waste disposal, Sewage disposal, Irrigation, Alfalfa, Bacteria, Lagoons, Municipal wastes

*Land application

J007

THE EFFECT OF ROAD DEICING SALTS ON SODIUM CONCENTRATION IN AN URBAN WATER-COURSE,

Scott, W. S.

York University,
Toronto, Ontario, Canada,
Geography Department.

Environmental Pollution, Vol. 10, No. 2, p 141-153, February, 1976. 4 fig, 1 tab, 11 ref.

The amount of de-icing salts in a Metropolitan Toronto stream and their spatial and temporal pattern of movement were studied. The stream was sampled during two major thaws at frequent intervals and at many locations which were closely spaced. The highest sodium concentrations occurred immediately after a thaw period started. They increased as much as fiftyfold during one thaw. These high concentrations last no longer than a few days, due to rapid dilution by melting snow. Both thaws occurred after long cold periods when salt and snow accumulated on roadsides. Because the very soluble salts are flushed downstream, salt may accumulate in lakes and ponds further downstream.

*Water pollution sources, *Runoff, *Sodium, Streams, Lakes, Snowmelt, Water pollution, Urban runoff

De-icing salts

J008

UTILIZATION OF WASTEWATER SLUDGE FOR AGRICULTURAL SOIL ENRICHMENT,

Hyde, H. C.

East Bay Municipal Utility District,
Oakland, California.

Journal Water Pollution Control Federation, Vol. 48, No. 1, p 77-90, January, 1976. 6 fig, 6 tab, 17 ref.

Waste water sludge was studied as a source of plant nutrients. Soil, groundwater, and plant samples were collected from field corn plots, pasture, irrigated pasture, and dry land. It seems to be feasible to use waste water sludge for soil enrichment subject to proper management and regulatory requirements. The soil type, topography, and sparse population of the study location were favorable for application of sludge on land. Quality and production of crops and forage were improved by sludge application. Salinity, nutrients, and trace elements did not significantly effect the soil-plant-water ecosystem. Pathogenic organisms survived in the sludge, but restricted public access and selection of crop systems and grazing animals would minimize the risks. The final status of regulatory requirements on the system is uncertain. The importance of public attitudes requires that aesthetic characteristics and effects on land quality and public health be thoroughly understood. An important technical obstacle to the process is the unknown effects of heavy metals in the sludge on the ecosystem and, eventually, in human food. The data obtained demonstrate the difficulties involved in assessing the long-term effects that heavy metals might produce.

*Heavy metals, *Groundwater, *Sludge disposal, Irrigation, Crops, Waste water treatment, Data collection, Heavy metals

Land application

J009
AGRONOMIC AND CATTLE STUDIES WITH MUNICIPAL LIQUID DIGESTED SLUDGE,

Lutrick, M. C., and Bertrand, J. E.

Agricultural Research Center, Jay, Florida.

In: Proceedings of the 22nd Annual Technical Meeting of the Institute of Environmental Sciences, April 26-28, 1976, Philadelphia, Pennsylvania, p 528-532. 1 fig, 7 tab, 8 ref.

Studies were conducted during 1975 to determine the crop responses, nutrient uptake and heavy metal accumulation on land treated with liquid digested sludge (LDS) and to evaluate the effects of feeding dried LDS to steers in terms of performance data, accumulation of heavy metals, microorganisms, and pesticides in the animal tissues. Corn, grain sorghum, and soybeans were grown on plots receiving 0, 7.5, 15.0, and 22.5 cm of LDS applied on an annual basis. The plots receiving no LDS were fertilized with a commercial preparation while LDS treated plots were not treated with a commercial fertilizer. Three experimental Holstein steers were fed a high roughage ration, containing 100 g of sun-dried LDS, for 219 days, while control animals were fed a high roughage diet containing no LDS. Yields from all three crops were reduced due to excessive rainfall. Soybean yields were higher from all levels of LDS application than from the commercial fertilizer treatment. The corn yield from commercial fertilizer treatment was higher than any of the LDS treatments. The higher applications of LDS produced greater sorghum yields than the commercial fertilizer although the lowest LDS application produced less yield. The lead content in the kidney tissue of the LDS fed steers was higher than that in the control animals. The content of Al, Cu, Fe, Mg, Ni, and Zn was lower in the liver of the LDS fed steers than in the control steers. Fecal coliform die-off tests performed by applying 5 cm of LDS to the soil surface with check, wet, dry, and incorporated techniques showed that about four months were required for complete die-off.

*Waste water treatment, *Sludge disposal, Agriculture, Agronomy, Crops, Cattle, Ultimate disposal, Crop response

*Land application, Liquid digested sludge

J010
HEPATITIS ATTRIBUTED TO POLLUTED STREAM,

Chapman, L.

Tacoma-Pierce County Health Department,
Tacoma, Washington.

Journal of Environmental Health, Vol. 38, No. 4, p 238-241, January-February, 1976. 1 fig.

Various epidemiological factors were studied in connection with an outbreak of Hepatitis-A in Salishan, Washington. The most affected group was schoolchildren; the second most affected was adults 25 to 34 years of age. Food sources, water supply, and rodent control at the local elementary school were investigated. The area was compared to two control tracts and another subsidized housing area. Water samples from a local stream were analyzed. No sources were found at the school itself. The incidence of hepatitis was much less in the control tracts, and the youngest case in the control tracts was 18 yr of age. No widespread hepatitis outbreaks were known to have occurred in other subsidized housing areas. Therefore poor hygienic conditions alone did not appear to have caused the outbreak. Water samples indicated pollution with coliform bacteria, and the ratio of coliform to strep bacteria suggested human sewage. The concentration of hepatitis cases along the drainage area of the stream and the popularity of the stream among children as a play area further helped to identify the stream as the source of infection. Storm drains empty into the stream, and it is believed that the stream becomes contaminated during periods of heavy runoff when runoff water is contaminated with sewage that cannot be absorbed by the soil. Immediate measures recommended include public notice of the polluted nature of the stream and a personal hygiene campaign at the local elementary school. Sewers should be constructed in the area, and storm sewer runoff should be treated along with other sewage.

*Epidemiology, *Public health, Diseases, Environmental sanitation, Water pollution, Water pollution sources, Water pollution effects, Storm sewers

J011

ANALYTICAL CHEMISTRY IN WATER POLLUTION CONTROL,

Mancy, K. H.

Pure and Applied Chemistry, Vol. 44, No. 3, p 555-568, 1975. 1 fig, 3 tab, 27 ref.

Optimal design of systems for measuring water quality should follow a rational stepwise procedure. The procedure includes defining short and long-term objectives, selecting parameters, sites, and frequency for measurement, and selecting analysis methods and data processing requirement. Developing a preliminary model able to satisfy the measurement objectives is very important. Such models can identify quantities and types of missing information as well as surplus information. The program and model may both be modified by cost-effectiveness analysis. An example of a strong water pollution measurement program is that set up in Poland with assistance from the United Nations Development Program and the World Health Organization.

*Model studies, *Water quality control, *Monitoring, *Measurement, Data collections, Data storage and retrieval

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J012

PHOSPHORUS DISTRIBUTION FROM SEPTIC TANK EFFLUENT IN COASTAL PLAIN SOILS,

Reneau, R. B., Jr., and Pettry, D. E.

Virginia Polytechnic Institute and State University,
Blacksburg,
Department of Agronomy.

Journal of Environmental Quality, Vol. 5, No. 1, p 34-39, January-March, 1976.
5 tab, 25 ref.

Phosphorus accumulations in Goldsboro and Varina sandy loams, both of whose water tables are high perched, were monitored to study the fate of phosphorus from septic effluent. Lateral and vertical phosphorus movements were determined with piezometers at selected depths and distances from the drainfield. Orthophosphate in the perched water tables decreased from 5.5 micrograms/ml in undiluted effluent to 0.32 micrograms/ml in Varina soil at 3.0 m distance and from 11.8 micrograms/ml to less than 0.20 micrograms/ml in Goldsboro soil at 3.0 m distance. Little orthophosphate was present in either soil at 12 m distance. The possibility of vertical movement contaminating permanent groundwater tables is limited, because the slowly permeable horizons were effective barriers to vertical orthophosphate movement. Phosphorus was concentrated at depths from 142 to 152 cm in the Goldsboro loam. The septic effluent did not appreciably alter fixed phosphorus quantities or phosphorus fraction distributions in the Goldsboro loam or farther than 3 m from the system in the Varina soil. Soil phosphorus fractions near the drainfield were present mainly as ammonium fluoride and sodium hydroxide extractable phosphorus and organic phosphorus. In the Varina loam, the ammonium fluoride extractable phosphorus fraction increased from 2 to 4 micrograms/g in the control profile to as much as 460 micrograms/g, and the sodium hydroxide extractable phosphorus fraction from between 40 and 50 micrograms/g to as high as 425 micrograms/g, at 0.15 m in the argillic horizons.

J013
USE OF HIGH LEVEL RADIATION IN WASTE TREATMENT — STATUS AND PROSPECTS,

Kobayashi, S.

Atomic Energy Review, Vol. 13, No. 3, p 615-621, September, 1975.

A symposium was held in March, 1975, on the application of high level radiation to waste treatment. Discussion included treatment and reuse of waste water, radiosensitivity of microorganisms, disinfection and microbiological control, chemical and physical modification of aqueous pollutants, economic and technological considerations, pilot-plant design and operating experience, and radiation treatment of non-liquid wastes. Ionizing radiation, possibly combined with other treatment methods, is useful in solving problems of waste treatment and reuse of spent resources. Several methods of increasing the cost-effectiveness of microbiological control are discussed. While the use of ionizing radiation to decompose aqueous pollutants has advantages, its yield is generally too low to compete successfully with other methods. There is still disagreement about the choice of radiation source, and cost-benefit considerations are still unclear. Several pilot plants using radiation treatment are already operating, and it is expected that commercial plants will soon be built. Recommendations included study of the surface properties of suspended sewage particles and their reaction with radiolytic species, reporting of end products and pollutional effects when pollutants are treated by radiation, further study of the natural resistance of microorganisms to radiation, and an experimental protocol for study of radiation treatment of sludge and waste water.

*Sewage treatment, *Waste water treatment, Irradiation, Cost-benefit analysis, Pilot plants

Ionizing radiation

J014
FLOATING STRUCTURAL PLASTIC TRUSS SYSTEM PROTECTS WASTE LAGOON LINING,

Andrews, R. K.

Water and Sewage Works, Vol. 123, No. 1, p 55, January, 1976.

A lagoon lining at a facility for waste treatment for a plant in Nitro, West Virginia, had to be designed to protect it from damage. The lagoon was planned to contain acidic wastes in variable depths. Supports and piping were to be designed for corrosion resistance and minimum outdoor maintenance. Structural plastic was designated for outlet and inlet piping supports for this reason. A pivoted truss system and floating platforms were designed and fabricated. A minimum lagoon water level prevents platform floats from resting on the lining. Fiberglass reinforced plastic piping having flexible joints at its truss pivot points was installed. The floating platform gave rise to some stability problems, but these have been corrected. The structural components have not noticeably deteriorated after approximately 2 years' operation. A long useful life is predicted for the system.

*Waste treatment, *Corrosion control, *Plastics, Construction materials, Pipes, Joints (connections)

J015

PREDICTING THE WATER POLLUTION POTENTIAL OF PROPOSED SANITARY LANDFILLS PART I: SANITARY LANDFILL LEACHATE...WHAT IT IS,

Oleckno, W. A.

Indiana University,
Bloomington,
School of Medicine.

Journal of Environmental Health, Vol. 38, No. 5, p 331-333, March-April, 1976.
5 tab, 12 ref.

Sanitary landfill leachate creates a water pollution threat to nearby groundwater sources and streams, although the problem can feasibly be prevented by adequate landfill location. Stabilization of a landfill includes biological decay, chemical oxidation, diffusion of gases, movement of liquids, dissolving and leaching of materials, movement of dissolved material, and uneven settlement. The biological decay is usually predominantly anaerobic, although there are zones where oxygen is available and decay is aerobic. Leachate may contain any of the decomposition products, such as organic matter, metallic cations, anions, and dissolved gases. Carbon dioxide dissolved in the leachate may increase the acidity. Initial leachate production depends on the time of emplacement and moisture content, but subsequent generation is seasonal in response to climatic conditions. Leachate has been found 80 ft below a landfill. Variables causing differences in leachate from different landfills include the amount and composition of refuse, its sorting and degree of compaction, the characteristics and amount of water in contact with it, the duration of contact with the water, and temperature. The leachate may be relatively heavily contaminated. However, the leachate always changes with migration, and natural strata can attenuate groundwater contaminated with leachate as it moves away from the fill area.

*Landfills, *Groundwater, *Water pollution sources, *Leachate, Anaerobic conditions, Hydrology

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J016

BENEFICIAL EFFECTS OF BAKING SODA ADDED TO SEPTIC TANKS,

Winneberger, J. H. T., and Weinberg, M. S.

Septic Tank Systems,
Berkeley, California.

Journal of Environmental Health, Vol. 38, No. 5, p 322-326, March-April, 1976.
2 fig, 2 tab, 12 ref.

Additives for septic tanks are discussed. Septic tanks are not generally designed for efficient operation, but dead zones could provide for gradual release of chemical additives. Experiments with fresh water in salt-water filled models showed that intermittent addition could be effective. Chemicals were also added to the water entering two actual septic tanks of different sizes; one had been cleaned recently. Their liquid volumes had considerable hydraulically less active zones which could store suspended or dissolved additives and exchange them slowly with active zones. Cationic flocculants increase flocculation, but in excessive amounts, can increase suspended solids. Experiments adding varied amounts of flocculant to raw sewage showed that an optimum amount of flocculant exists at which maximum removals of suspended solids occur. Due to their rather narrow effectiveness range, cationic polymers could cause problems as septic tank additives, due to varying septic tank sizes and the tendency of some homeowners to add more than the recommended quantities. Baking soda is being added to septic tanks as a result of its use to deodorize drains. One study found that the addition of baking soda improved flocculation of suspended solids. Another study found that adding sodium bicarbonate, sodium chloride, sodium carbonate, sodium hydroxide, potassium bicarbonate, and potassium chloride to septic tank effluents decreased suspended solids and turbidity.

*Septic tanks, *Chemical precipitation, *Suspended solids, *Domestic wastes, *Waste water treatment, *Flocculation, Sodium compounds

J017

PREDICTING THE WATER POLLUTION POTENTIAL OF PROPOSED SANITARY LANDFILLS PART II: AN INDEX OF THE WATER POLLUTION POTENTIAL OF SANITARY LANDFILLS,

Oleckno, W. A.

Indiana University,
Bloomington,
School of Medicine.

Journal of Environmental Health, Vol. 38, No. 5, p 334-336, March-April, 1976.
2 ref.

Many factors must be considered in selecting a site for a sanitary landfill. Although landfills may pose serious hazards, landfills can be planned and maintained that will not harm water quality. A numerical index indicating the water pollution potential of proposed sanitary landfills was developed, with point values assigned to various gradations of the criteria. The criteria were precipitation, soil type between the landfill bottom and the maximum water table, and distance between the landfill bottom and the maximum water table. The index does not replace a detailed survey. Because leachate flows slowly through slightly permeable strata, attenuation has a greater chance to occur. Due to possible fractures where channeling might occur, shale, dolomite, and limestone were assigned the same point value as gravel. Since flooding may rapidly bring refuse cells to field capacity and produce large volumes of leachate, the flooding frequency should be once in 50 yr or less. If a site is considered satisfactory by the index, surface water over 200 ft away from it probably will not be contaminated. The index indicates that, all other factors being identical, a site over clayey silt 6 ft above the maximum water table is preferable to a site over 5 ft of fine sand over fractured sandstone with a maximum water table at 15 ft. Even fills found satisfactory should be investigated further to ensure that the data used was fully representative of the site. A site with one satisfactory portion may not be satisfactory 20 ft away, due to a shift in underlying rock or soil conditions. After the site is developed, monitoring wells should be drilled and nearby streams sampled periodically to insure that water pollution by leachate is not occurring.

*Leachate, *Landfills, *Waste disposal, *Soil mechanics, Flooding, Environmental engineering, Sanitary engineering

J018

CHLORINE LOOKS SECURE AS WATER REAGENT,

Canadian Chemical Processing, Vol. 60, No. 3, p 28-29, March, 1976.

Unwanted contaminants may be introduced into the environment by water disinfection with chlorine. Water chemists suspect that some of the chloro-compounds that persist in nature are generated during water disinfection. Industry and agriculture do not account for all the chloro materials released to the environment. Primary effluent is usually toxic to fish; unchlorinated secondary effluent is nontoxic; and either stream containing 0.1 mg/liter residual chlorine is toxic for several hr, depending on water aeration. The chlorine residual is soon lowered to below the toxic threshold, 0.02 mg/liter, by lagooning/aeration. Use of a reducing agent, such as sulfur dioxide, to treat the chlorinated water also neutralizes the residual chlorine. When chlorine is added to effluent, it reacts to form several compounds including chloramines, which reduce coliform bacteria counts and are toxic to fish. Treatment with sulfur dioxide decomposes the chloramines and renders the water nontoxic. Chlorination costs about 7 cents/Imperial gal, and dechlorination would add another cent/1000 Imperial gal. A pilot unit disinfecting waste water with gamma rays was compared with a chlorination unit of similar size. The gamma irradiator performed well and had no 'gross interaction with the waste water' other than its biocidal action. Costs for gamma radiation to produce disinfection similar to that produced by chlorine have been estimated at 64 cents/1000 gal. Gamma radiation will probably not be used to treat waste water unless this cost is drastically reduced.

*Chlorine, *Disinfection, *Toxicity, Aeration, Lagoons, Pilot plants, Gamma rays, Waste water treatment

Dechlorination

J019

MUDS, SLIMES AND SLUDGES,

Arnold, R.

Proceedings of the Royal Australian Chemical Institute, Vol. 43, No. 2, p 51-53, February, 1976. 1 fig, 11 ref.

Waste discharges of finely divided solids suspended in water are usually treated by coagulation and settling, but not all suspensions settle out readily. Although inorganic slurries sometimes cause problems, organic sludges, such as those produced from sewage, textile processing, or the food industry, are always difficult to dewater. These pose a serious problem since they usually are produced in populous areas. However, quantities of these sludges are much smaller than those of inorganic sludges from mining. Due to the smaller quantities, sedimentation can be supplemented with filtration and other more costly processes. Organic sludges' main components are crosslinked natural hydrophilic polymers, such as proteins or carbohydrates. Probably stabilization is due largely to a sort of inbuilt 'stearic stabilization', and charge has a less important role. The only practical way of inducing this kind of colloid to settle is some type of flocculation. Most of the troublesome sludges are already flocculated, but the sediment is a more or less structured gel retaining a large amount of water. Mechanically breaking the structure enables more water to be removed from the sediment. The sediments are usually compressible, and higher solids contents will result under loading from deep beds. This loading effect also benefits filtration.

*Sludge analysis, *Sludge treatment, *Sewage sludge, Organic compounds, Suspended solids, Waste disposal, Filtration, Sedimentation

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J020

OPERATION AND IMPACT OF NPDES IN REGION II PART I,

Muszynski, W. J., and Olenik, T. J.

Water and Sewage Works, Vol. 123, No. 5, p 62-65, May, 1976. 2 tab, 7 ref.

The Federal Water Pollution Control Act Amendments provide Federal grants for construction of public waste water treatment works and establish interim effluent standards and the National Pollutant Discharge Elimination System (NPDES) permit program. Requirements are provided which systems must meet in order to receive permits. Region II includes Puerto Rico, the United States Virgin Islands, and the states of New York and New Jersey. The initial problems regarding permits for publicly owned discharges involved funding, pre-treatment of industrial wastes, combined flow, and the lack of discharge information. The last is the most serious problem, and it is complicated by the lack of understanding of the permit program by the municipalities. Several reviews of an application are necessary before a permit is issued. The steps in processing a permit include developing a preliminary draft of conditions for the treatment plant, certification by the state, public notice, and issuance of the permit. Attempts are made to verify the information provided on application forms. Where secondary treatment facilities do not currently exist, interim effluent requirements are aligned with the construction schedule for the secondary facilities. Secondary plants capable of achieving the required treatment level would be required to study what could be done to raise their treatment levels. In some instances existing secondary treatment plants would receive two compliance schedules, one related to the permit and the other related to construction grants for plant improvement.

*Waste water treatment, *Treatment facilities, *Permits, *Legislation, *Federal Water Pollution Control Act, Standards, Grants, Effluents, New Jersey, New York, Puerto Rico, Virgin Islands

Discharge permits (NPDES)

J021

RECLAMATION OF A BURNED ANTHRACITE REFUSE BANK WITH MUNICIPAL SLUDGE,

Sopper, W. E., Kardos, L. T., and Edgerton, B. R.

"The Pennsylvania State University,
University Park, Pennsylvania,
School of Forest Resources.

Compost Science, Vol. 17, No. 2, p 12-19, March-April, 1976. 7 tab.

The use of municipal effluent and sludge to fertilize a burned anthracite refuse bank was studied. A burned anthracite refuse bank was divided into three plots, one of which was not irrigated, one irrigated with effluent, and one irrigated with fresh water. Different sludge application rates were used on different parts of each plot. Ten species of trees, five species of grasses, and five species of legumes were planted in the plots. It was shown that heat-dried sludge, municipal sewage effluent, or a combination may successfully revegetate burned anthracite refuse banks. Irrigation with only fresh water was helpful in establishing seeded legumes, but grasses responded more strongly when sludge was also applied. More tree seedlings survived at the lower rates of sludge application. However, the seedlings that survived showed greater height growth at higher application rates. The hardwood trees, especially hybrid poplar and black locust, had greater potential to revegetate burned refuse banks than the conifers. All of the hardwoods had better survival rates than the best conifers. The species with the highest survival rate was black locust. After one season, black locust and hybrid poplar had the greatest height growth. Hardwoods also grow best with a herbaceous cover. The fast growing legumes and grasses quickly overtop and suppress the slowly growing conifers. The best overall sludge application rate was 34 tons/acre in terms of growth of herbaceous vegetation. Eighteen tons/acre was second best for establishing herbaceous vegetation. Grasses were better suited for revegetation than legumes, which responded poorly under competition.

*Sludge disposal, *Land reclamation, *Fertilization, *Application methods, *Sewage effluents, Irrigation, Vegetation establishment, Trees, Grasses, Legumes, Crops

Land application

J022

GREAT LAKES POLLUTION CLEANUP STAGNATES AS PROBLEMS MOUNT,

Engineering News-Record, Vol. 196, No. 22, p 26-27, May 27, 1976. 1 tab.

Municipal and industrial water pollution problems being experienced by cities on the shores of the Great Lakes are reviewed along with legal, financial, and bureaucratic difficulties impeding their solution. Lake Erie is generally considered to be the most severely polluted of the lakes, with water quality in Cleveland harbor being poor with respect to biochemical oxygen demand, phosphorus, nitrogen, total dissolved solids, and coliforms. A year-long holdup in the building of the city's 50 million gallon/day physical-chemical sewage treatment plant is the result of protests of potential contractors who were beaten out in the bidding. Other delays associated with environmental impact statements required by the Environmental Protection Agency are also a problem. Similar delays are being experienced by other cities on the Great Lakes in terms of deadlines set for both industry and the municipalities. In contrast to the Lake Erie situation, water quality for Lakes Michigan, Superior, and Huron is generally good.

*Sewage treatment, *Municipal wastes, *Industrial wastes, *Great Lakes, Great Lakes region, Lake Erie, Waste water treatment, Treatment facilities, Water quality, Water pollution effects, Legal aspects, Financing

J023

TECHNIQUES FOR POWER MEASUREMENT FOR SURFACE AERATOR,

Kaul, S. N., and Raman, V.

Indian Journal of Environmental Health, Vol. 17, No. 3, p 232-237, 1975. 3 fig, 14 ref.

A review of techniques used for measuring the power output from surface aerators is presented along with a comparison of two laboratory methods used for power measurements on full scale aerators. Configurations using an induction motor connected to an alternating current source versus those using a direct current generator as the power source were compared, and the latter type was found more suitable for power input/output and efficiency calculations since it was not affected by frequency changes and skin effects associated with the alternating current configuration. The net power consumed by full-scale aerators was calculated by multiplying the output power by the gear efficiency.

*Aeration, *Electrical properties, *Efficiencies, *Electrical design, Evaluation, Performance, Waste treatment, Equipment

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J024

SOFTENING AND COAGULATION SLUDGE-DISPOSAL FOR A SURFACE WATER SUPPLY,

Burris, M. A., Cosens, K. W., and Mair, D. M.

Alden E. Stilson and Associates,
Columbus, Ohio.

American Water Works Association Journal, Vol. 68, No. 5, p 247-257, May 1976. 13 fig, 8 tab.

Results from pilot plant studies at two surface water treatment plants in Columbus, Ohio, dealing with the feasibility of recovering quicklime from the calcium carbonate in softening sludge as well as methods of sludge disposal are presented. The studies indicate that quicklime which is suitable for reuse can be recovered with an 86% calcium oxide content. Waste streams from centrifugation and sludge concentration processes which contain large quantities of dissolved magnesium require stabilization in lagoons, with the supernatant being returned to the surface stream below the intake dam. Recarbonation, concentration, and centrifuging of softening sludge are required to reduce impurities in the product quicklime in order to ensure continuous high quality for recycling. These steps, together with an efficient first stage clarification process, are essential when a turbid surface water supply is the source. Coagulation sludges must be removed ahead of the softening operation and kept separate. Alum sludges can be concentrated and dewatered by centrifuges or filter presses; the latter produce a more satisfactory cake and a better filtrate for return to the process.

*Water quality control, *Sludge treatment, *Water softening, *Surface waters, *Sludge disposal, *Byproducts, Treatment facilities, Calcium carbonate, Lagoons, Magnesium, Recycling

J025

A FEASIBILITY STUDY OF THE CONTROL OF POLLUTION FROM INDUSTRIAL WASTE WATERS DISCHARGED INTO THE LAGOON OF VENICE,

Chalmers, R. K., and Jenkins, S. H.

Bostock Hill and Rigby,
Birmingham, Great Britain.

Water Pollution Control, Vol. 75, No. 2, p 176-191, 1976. 4 fig, 7 tab, 5 ref.

The feasibility of controlling industrial waste water discharged into the lagoon of Venice was investigated. Studies of the water quality in the lagoon and different canals throughout Venice revealed average nitrogen (as ammonia) concentrations ranging from 1.07 g/liter at Marittima to 6.49 g/liter at Fusina with corresponding chemical oxygen demand values of 32.71-34.31 mg/liter during the 1969-1970 period. Two technically feasible treatment alternatives were identified. One method involved making maximum use of the public sewer for industries preferring this disposal method and treating the remaining industrial effluent at one or more plants on the industrial site. The other alternative was to make maximum use of the public sewer and sewage treatment capacity, with the remaining portion of the industrial effluent being conveyed through a new and separate sewer to the sewage works for combined treatment with sewage. On the basis of costs for the treatment of similar chemical wastes using activated sludge and sludge incineration, the cost of treating the major part of the industrial effluent (about 75% of the load) on the industrial site appeared to be about the same or slightly greater than that for combined treatment at the sewage works.

*Industrial wastes, *Waste water treatment, *Feasibility studies, *Water pollution effects, *Lagoons, Treatment facilities, Sewage treatment, Evaluation, Chemical oxygen demand, Nitrogen, Ammonia, Sewers, Activated sludge, Costs, Effluents

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J026

FLUID-MECHANICS ASPECTS IN THE DESIGN OF SEWAGE OUTFALLS INTO THE SEA (STROEMUNGSMECHANISCHE ENTWURFSASPEKTE FUER ABWASSEREINLEITUNGEN INS MEER),

Kobus, H.

Universitat Karlsruhe,
Karlsruhe, Germany,
Institut fur Hydromechanik.

Wasserwirtschaft, Vol. 66, No. 5, p 148-155, 1976. 11 fig, 12 ref.

Pollutants whose decay times are several days long can be disposed of with carefully designed ocean outfalls. The fluid mechanics of mixing and transport of the discharged wastes must be known to assess the effects in terms of water pollution. The outfall diffuser geometry and position can strongly influence the dilution process. Proper outlet structure design, therefore, allows the initial dilution to be optimized and, when density stratification occurs, allows the sewage field to be submerged below the surface.

*Sewerage, *Outfall sewers, *Waste disposal, *Waste dilution, *Oceans, *Fluid mechanics, Mixing, Outlets

Transport

J027

CITIES NEED SEWERLESS TOILETS,

Nesbitt, P. M., and Seldman, N. N.

Institute for Local Self-Reliance,
Washington, D. C.

Building Systems Design, Vol. 73, No. 3, p 11-17, April/May, 1976. 10 ref.

Compost toilets may have advantages in urban as well as rural areas. Alternatives to centralized physical-chemical waste water treatment technologies should be considered due to tough water quality standards and increasing costs of labor, energy, and chemicals. Upgrading and expansion of treatment plants are not expected to significantly improve overall river quality, because erosion and runoff problems are being ignored. Expansion and upgrading costs for treatment facilities are high, and operating costs are increasing. As sewage treatment improves, greater quantities of sludge are produced. The size of the waste load should be reduced. Sewer pipe should be repaired so that groundwater does not seep into the system, where it is treated unnecessarily. Sewerless toilets theoretically could eliminate the problems of large, centralized sewerage systems. One of these, the compost toilet degrades the wastes naturally to produce compost. Aerobic tanks are similar to septic tanks, but air is mixed into the tank, making them more reliable in areas where ordinary septic tanks have failed. Incineration toilets, which have been used effectively in remote areas, use large amounts of energy but could still be less expensive than centralized treatment. The closed loop oil-flush toilet is also available, which is flushed with a mineral oil from which the wastes are separated by gravity, so that the oil can be reused.

*Waste water treatment, *Sewage treatment, *Sewerage, *Treatment facilities, *Sewers, Sewage disposal, Costs, Biodegradation, Incineration

Sewerless toilets

J028

REPORT ON POLLUTION OF INTERSTATE WATERS OF THE CONNECTICUT RIVER,

United States Department of Health, Education, and Welfare,
Cincinnati, Ohio,
Robert A. Taft Sanitary Engineering Center.

November, 1963, 65 p. 6 fig, 5 tab, 1 append. Technical Report PB 245 744.

Pollution of interstate waters of the Connecticut River is reported, based on previous reports, official Public Health Service records, and data from a field study in September and October 1963. Various state and local agencies and individuals also provided data and information. Both river water and sewage were sampled and analyzed. Sixty-two miles of the river, from Hatfield, Massachusetts, to 12 miles below Hartford, Connecticut, were studied, as were portions of the Chicopee and Westfield rivers, tributaries of the Connecticut River near Springfield, Massachusetts. Two dams on the Connecticut River and several small dams on the other two rivers provide hydroelectric power and industrial process water. The river receives raw and partially treated sewage from a population of 750,000 and industrial discharges equivalent to raw sewage from a population of 100,000. As a result, it is excessively polluted. In 1963, bacterial quality of the water did not meet common water pollution control objectives at any point on the river. The suspended solids produced sludge deposits from a short distance below Holyoke Dam to Enfield Dam. Dissolved oxygen was intermittently depleted below the desirable level by the oxygen demand of the decomposing wastes. Visual evidence of pollution included cloudy water near discharges, intermittent dye colors from industrial wastes, small grease balls, bits of excreta near sewage discharges, and intermittent oil films. Wastes discharged into these rivers in Massachusetts endanger Connecticut residents' health and welfare, and are therefore subject to abatement under the Federal Water Pollution Control Act.

*Pollutant identification, *Sewerage, *Sewage, *Water quality, Natural streams, Industrial wastes, Tributaries, Degradation (stream), Downstream, Impounded waters

J029

AEROSOL PRODUCTION FROM LAND APPLICATION OF WASTEWATER BY AGRICULTURAL IRRIGATION EQUIPMENT,

Raunor, G. S., and Hayes, J. V.

Brookhaven National Laboratory,
Upton, New York.

1975, 2 p. 1 fig. Technical Report BNL 19847.

Dye particles resulting from evaporated spray droplets were sampled to study aerosol production from sprays of four agricultural nozzle systems. This investigation was part of a larger study evaluating upland recharge of waste water as an alternative to conventional sewage treatment and as a means to return water to underground aquifers after removal of nutrients by growing vegetation. Only a small percentage of the dye-containing water was aerosolized, but 10 to the 10th power or more particles were produced per min from single nozzles. Most droplets were smaller than 100 micron. The number of aerosol particles produced is related to wind speed and the length of time the liquid stream is exposed to the wind. Fewer aerosols are produced at low wind speeds from low spraying nozzles, but concentrations may be higher because dilution by the airflow is less. Emitting fixed amounts of liquid may result in production of fewer aerosols at greater flow rates due to shorter operating time and shorter exposure to the wind.

*Waste water treatment, *Sewage treatment, *Treatment facilities, *Aerosols, *Application methods, Land use, Irrigation, Drops (fluids), Spraying, Sprinkler irrigation

Land application

J030

FEASIBILITY OF USING SEWAGE SLUDGE IN HIGHWAY EMBANKMENT CONSTRUCTION,

Kawam, A., Smith, L. M., Ross, J., Larew, H. G., and Rude, L.

Gillette Research Institute,
Rockville, Maryland.

February, 1975, 44 p. 11 fig, 23 tab. Technical Report PB-242 260.

The possible use of sewage sludge combined with other by-products and wastes in constructing a highway embankment was investigated in the laboratory. The mixtures evaluated contained lime, fly ash, waste calcium sulfate, and up to 17% sewage sludge. The effect of fly ash source, lime type, and relative proportions of fly ash, lime, and waste calcium sulfate on the compressive strength of compacted speciments was measured. For over 75% of the formulations, the 28-day compressive strength was 50 psi greater than that of uncured speciments. In selected formulations, 30, 50, and 70% of the fly ash was replaced with two soils, one sandy and the other clayey. For all samples with the soil replacement, the 28-day compressive strength was at least 50 psi greater than that of uncured specimens. Volume change, durability, permeability, and leachability tests were performed on selected formulations. The mixes broke up considerably in the freeze-thaw and wet-dry tests. The permeability was of the order of 0.000006 cm/sec. The heavy metals in the sewage sludge, cadmium, chromium, mercury, and zinc, were retained in the mixture rather than entering the leachate in the permeability tests. The pH and calcium and sulfate ion concentrations in the leachate were increased by lime and gypsum. Small quantities of sewage sludge can be mixed with soil, lime, fly ash, and waste sulfate to produce a material suitable for use in highway embankments. The embankments should be so zoned during construction that the sewage sludge treated materials are at least 3 ft below any exposed surfaces, to prevent freeze-thaw or wet-dry breakup of the material.

*Sewage sludge, *Lime, *Fly ash, *Calcium sulfate, *Sludge disposal, Soils

J031
DIRECTORY OF EPA, STATE AND LOCAL ENVIRONMENTAL QUALITY MONITORING AND ASSESSMENT ACTIVITIES,

Scotton, J. W., Mullen, K. T., Whitman, J., and Citron, R.

Smithsonian Institution,
Cambridge, Massachusetts,
Center for Short-Lived Phenomena.

1974, 384 p. 139 tab. Technical Report PB-241 757.

Federal environmental quality monitoring and assessment programs within the Environmental Protection Agency are described, juxtaposed with corresponding, although not necessarily administratively related, national, state, and local monitoring activities. Seven areas are discussed: air, water quality, interstate water carrier supplies, pesticides, radiation, noise, and solid waste. The administration and purpose of the EPA office monitoring each are described. The data in the directly was obtained from EPA. Detailed descriptions of individual monitoring activities were clarified by state and local agencies. This account is not exhaustive, but it provides a first approximation of the types and distribution of monitoring activities.

*Pollutant identification, *Programs, *Monitoring, *Assessments, *Administrative agencies, *Governmental interrelations, Local governments, State governments, Federal government, Air pollution, Water pollution

Directories

J032
SORPTION CAPABILITIES OF SOILS FOR PHOSPHATE REMOVAL,

Zarnett, G. D.

Ministry of the Environment,
Toronto, Ontario, Canada,
Applied Sciences Section.

January, 1976, 56 p. 14 fig, 40 ref. Publication No. S58.

The efficiency of a septic tank tile field system depends heavily on the capability of the soil, which acts both as a filter and an ion exchange-adsorption medium, to remove potentially detrimental contaminants. Soil samples were analyzed to determine the amount of phosphorus already present and the amount of phosphorus that would rapidly be taken up by the soil. Phosphorus removal from effluents passing through soil took place by a combination of ion exchange, physical adsorption, and precipitation. Ion removal was related to the clays' structure and mineral content. Clays act by ion exchange and prefer the counter ion of higher valence. Selectivity increases with decreasing hydrated radius. Phosphate isotherms were determined by a 24 hr batch equilibration with a solution of a known phosphorus concentration. The degree of sorption by combined mechanisms was evaluated by an equilibrium-adsorption procedure. The Langmuir Isotherm Equation was used to correlate the equilibrium distribution between the soil and liquid phases. The Langmuir model can be readily extended to multi-species solutions. The rate of phosphorus movement in the soil was estimated using a form of the Langmuir Isotherm Equation, which also applies to the movement of other contaminants in groundwater flow. The life-time of the particular soil-groundwater system was then determined from the groundwater flow rate and the calculated ratio of water to contaminant velocity.

*Waste water treatment, *Sorption, *Soils, *Phosphates, *Efficiencies, Soil filters, Ion exchange, Adsorption, Nutrient removal, Septic tanks

J033
HOW TO USE AND SELECT A SCREW PUMP,

Berk, W. L.

Lakeside Equipment Corporation,
Bartlett, Illinois.

Water and Sewage Works, Reference number, p R-22, R-24-R-27, April 30, 1976.
4 fig, 1 tab.

The use of screw pumps for moving large quantities of liquid at a relatively low lift is discussed. Screw pumps are currently being used in the following applications: activated sludge return, raw sewage lift stations, raw and effluent sewage plant lift stations, industrial product and waste handling, storm water pumping, irrigation, land drainage, and the delivery of a constant flow to treatment works with equalization basins. Screw pumps require less total dynamic head, operate at higher efficiency, and require less energy for a given application when compared with centrifugal pumps. Selection criteria and design considerations for screw pump applications are outlined. The mathematics of a hypothetical pump selection are developed in terms of total lift and pump speed, drive selection, screw pump loadings, and deflection. A tabulation of screw pump lift and capacity data is also presented.

*Pumps, *Pumping, *Waste treatment, *Sewage treatment, *Hydraulic equipment, Evaluation, Performance, Efficiencies, Flow, Equipment, Irrigation systems, Treatment facilities, Surface drainage, Hydraulic engineering

J034
INTER-RELATION OF KEY-FACTORS FOR INFILTRATION OF LIQUID DOMESTIC WASTE INTO SOIL,

Kropf, F. W.

Dissertation Abstracts International B, Vol. 36, No. 11, p 5744, May, 1976.

Soil disposal systems are frequently a valid alternative to aquatic disposal; their long term absorption capacity is controlled by either the hydraulic criterion or the infiltration criterion, which is the acceptance rate of the biological slime layer at the soil interface. Columns of three representative soils were flooded with septic tank effluent, either continuously, for 6 hours once a day, or for 12 half hour periods daily. Intermittent flooding was not advantageous for long term operation. The biological slime layer causing the clogging did not become completely impervious; the minimum infiltration rates were one to 2 cm/day. The effect of soil peremability on absorption rate was relatively small, provided the system was governed by the infiltration criterion. The infiltration interface orientation did not affect the infiltration rate. Continuous slime layer inundation did not adversely affect its capability to infiltrate liquid. Various design recommendations are outlined for fail-safe operation of small scale soil infiltration systems.

*Waste water treatment, *Infiltration, *Infiltration rates, *Waste disposal, *Effluents, Domestic wastes, Liquid wastes, Absorption, Septic tanks

Land application, Septic tank effluents

J035

FIBER-GLASS-REINFORCED POLYESTERS AND FURAN RESINS FOR WATER- AND WASTE-TREATMENT SYSTEMS,

Szymanski, W. A., and Talbot, R. C.

Ashland Chemical Company,
Columbus, Ohio,
Resins and Plastics Division.

American Water Works Association Journal, Vol. 68, No. 5, p 228-231, May, 1976.
2 fig, 3 tab, 6 ref.

Properties of fiberglass-reinforced polyester and furan resins are reviewed in relation to their use in water- and waste-treatment applications. These materials show good chemical resistance was well as resistance to bacteria, algae, fungi, and mildew. The strength characteristics of furan laminates compare favorably to those of ordinary carbon steel and aluminum. The coefficient of thermal expansion of fiberglass-reinforced plastics is about twice that of steel or concrete and about the same as that of aluminum. A large water treatment plant capable of reclaiming chrome and process water at a rate of 6000 gallons/min is currently using fiberglass-reinforced polyester and furan linings for the inlet flume and trough, the equalization tank, two treatment tanks, two reaction tanks, a drain sump, an acid sump, steel storm retention tanks, clarifiers, and thickeners.

*Linings, *Resins, *Plastics, *Polymers, *Materials, *Waste water treatment, *Corrosion control, Physical properties, Treatment facilities, Equipment, Waste treatment, Bacteria, Algae, Fungi, Mildews

Fiberglass, Furan

J036

AN ASSESSMENT OF THE AIRBORNE EMISSION OF SELECTED VIRUSES BY WASTEWATER TREATMENT FACILITIES,

Fannin, K. F.

Dissertation Abstracts International B, Vol. 36, No. 11, p 5493, May, 1976.

Airborne emission of viruses causing cytopathic effect (CPE) in monkey kidney cells, coliform bacteria, and bacteriophages forming plaques on two Escherichia coli strains from trickling filter and activated sludge waste water treatment plants were assessed. Large volume air samplers, with an attached recirculation apparatus, and Anderson samplers were used for field sampling. Low levels of bacteriophage emissions were observed, but animal viruses were not detected in aerosols. Concentrations of bacteriophages in sewage and their levels in air were compared. This ratio was then compared with sewage animal virus levels to estimate minimal airborne animal virus concentrations. These estimates are less than the sensitivity of the procedures used. The susceptibility to infection and density of the exposed downwind population should be considered in interpreting these estimates' significance. The effects of meteorological conditions on airborne bacteriophage and coliform bacteria recovery were observed. There were significant correlations between relative humidity and bacteriophage recovery and between windspeed and coliform bacteria. There was an inverse correlation between temperature and coliform bacterial levels. Coliform bacteria do not seem appropriate as indicators of viral air pollution, since their survival was lower than that of bacteriophages. Bacteriophages probably would better indicate this type of pollution.

*Waste water treatment, *Pollutant identification, *Activated sludge, *Viruses, *Trickling filters, *Sewage, Treatment facilities, Bacteriophage, Coliforms

Animal viruses

J037

MANAGEMENT OF WATER RESOURCES UNDER DIFFERENT SOCIO-ECONOMIC CONDITIONS,

Bokhari, S. M. H.

Dissertation Abstracts International B, Vol. 36, No. 11, p 5491, May, 1976.

Major lags still exist between the developed and developing countries with respect to water management, and theory and practices diverge even in the developed countries. The Wellton-Mohawk Irrigation District in the United States and the Salinity Control and Reclamation Project Number One in Pakistan are compared as examples of water management under different sociological conditions. Multi-disciplinary teams of professionals from developing countries should be trained to make planning and management more effective. Implementation capabilities in developing countries should be improved, so that projects can be completed more rapidly. Adequate financial allocation is required during implementation and operation. The latest rain harvesting and runoff agricultural techniques should be introduced in dry farming areas in Pakistan's upland plateau. Tubewells will make the system more flexible and save funds for important complementary programs. There should be more emphasis on planning, operations, and evaluation of public investments concerned with water.

*Water management (applied), *Planning, *Social aspects, *Regional economics, *Regional development, Regional analysis, United States, Asia

Pakistan

J038

OWRT INTEREST IN NEW TECHNOLOGIES FOR WATER TREATMENT,

Butcher, W. S.

In: 80th Annual Meeting of the American Institute of Chemical Engineers, September 7-10, 1975, Boston, Massachusetts, 12 p.

The Office of Water Resources Research and the Office of Saline Water Conversion were combined in July 1974 to form the Office of Water Research and Technology (OWRT). New functions were added to the old functions incorporated in the new office. The new office's objectives are to develop new knowledge needed to mitigate or solve important water resource problems and to help disseminate research results. The programs to achieve these objectives include research, development, scientific information dissemination, and technology transfer. Problems studied include the hydrologic cycle, water supply and demand, conservation, and methods of increasing water supplies. Research is performed by contractors. Three major areas of research are surface and groundwater treatment technologies; technologies making impaired waters usable; and saline water conversion technologies for municipal, agricultural, and industrial uses. A Water Resources Scientific Information Center is included in OWRT. The technology transfer program is still in a formative stage. The OWRT was established to provide a more responsive system relating water research and results to actual problems.

*Water treatment, *Water conservation, *Water purification, *Water resources, *Technology, *Research and development, Federal government, Desalination, Impaired water quality, Saline water, Water sources, Water supply

*Office of Water Research and Technology

J039

DO REGULATED FREIGHT RATES DISCOURAGE RECYCLING?,

Albrecht, O. W.

United States Environmental Protection Agency,
Cincinnati, Ohio,
Municipal Environmental Research Laboratory.

News of Environmental Research in Cincinnati, November 14, 1975, 4 p. 1 fig, 2 tab, 9 ref.

Two Environmental Protection Agency (EPA) studies did not prove conclusively discrimination by Interstate Commerce Commission (ICC)-regulated rates against secondary materials. A study by the Research Planning Institute (RPI) implied that discrimination, in the ICC sense, might exist for rates for motor carriers weighted by amounts of necessary chemical constituents for paperboard manufacture. The study did not document, however, that the rate differences actually affected long-run decisions involving plant locations and raw material substitutions. The Moshman Associates study compared percentage contributions to variable cost of different rates per ton-mile. To the extent that the costs were representative, the study implied that economic discrimination existed for ferrous scrap because the applicable rates did vary from incremental costs on long hauls compared to iron ore rates. Discrimination was also suggested for cullet and reclaimed rubber because their contribution percentages were higher than those for their new counterparts. Questions have been raised as to whether ICC costing procedures are appropriate. The basic issue of rate discrimination is related to national goals for regulation of common carriers. There are, at present, no clear criteria for freight rates. It is generally inappropriate to determine discrimination on the basis of incremental cost pricing due to the nature of costs prevailing for railroads. New decision rules are needed if regulation of freight rates is to encourage a social goal, such as recycling. Since the EPA analyses, several general rate increases have occurred, and the ICC ordered holddowns for some of these on certain recyclable commodities.

*Regulation, *Rates, *Recycling, *Transportation, *Discriminatory pricing, Railroads, Chemicals, Iron, Rubber

Interstate Commerce Commission, Secondary materials

J040

PESTICIDE INCINERATION,

Carnes, R. A., and Oberacker, D. A.

United States Environmental Protection Agency,
Cincinnati, Ohio,
Municipal Environmental Research Laboratory.

News of Environmental Research in Cincinnati, April 15, 1976. 4 p, 3 fig, 11 ref.

An experimental pilot-scale incineration system was designed and constructed to evaluate the effect of operating variables on the efficiency of pesticide destruction. Fifteen commercial formulations of nine pesticides representing the major classes of organic pesticides were individually tested. Stack gases from the incineration tests were analyzed for sulfur dioxide, oxides of nitrogen, carbon monoxide, carbon dioxide, methane, total hydrocarbons, and particulates. When organonitrogen and organophosphate pesticides were tested, analyses for cyanide and total pyrophosphates, pesticides can be destroyed. For each pesticide, a range of temperature retention times exists at which more than the necessary 99.99% is destroyed. Temperature and retention time in the combustion chamber were the two most important operating variables. Certain conventional solid, liquid, or sludge waste incinerators, with adequate retention time and operating temperature, could be used for pesticide incineration with an appropriate injection method. Emissions requiring control include particulates from solid formulations, phosphorus pentoxide from phosphorus-based pesticides, hydrogen chloride from chlorinated hydrocarbons, cyanide from nitrogen-containing organics, and sulfur dioxide.

*Pollutant identification, *Treatment facilities, *Organic pesticides, *Incineration, *Ultimate disposal, Smoke, Chlorinated hydrocarbon pesticides, Pilot plants, Efficiencies, Odor, Air pollution

J041
INTERNATIONAL CONFERENCE ON ENVIRONMENTAL SENSING AND ASSESSMENT, VOLUMES 1 AND 2,

World Health Organization,
Geneva, Switzerland.

September 14-19, 1975, Las Vegas, Nevada, 500+ p.

More than 200 conference papers dealing with topics related to environmental sensing and assessment techniques are presented, with 57 of the presentations dealing with water resources. Topics covered include: surface-groundwater relationships; groundwater contamination; estuarine circulation; the identification of water pollutants; pollutant pathways in ground, surface, and coastal waters; the effects of pollutants on water uses; waste treatment and disposal processes; water quality control; methods for evaluating monitoring projects; the legal aspects of monitoring aquatic environments; the design of monitoring networks; remote sensing techniques; collection and sample preparation methods; laboratory analytical methods; and field monitoring devices.

*Monitoring, *Analytical methods, *Legal aspects, *Water quality, *Pollutant identification, Flow, Surface waters, Groundwater, Oceans, Estuaries, Network design, Waste disposal, Equipment

Conferences

J042
LEGAL REQUIREMENTS FOR MONITORING GROUNDWATER QUALITY,

Banks, H. O., and McMillion, L. G.

Harvey O. Banks Consulting Engineer, Incorporated,
Belmont, California.

In: International Conference on Environmental Sensing and Assessment, Vol. 1, September 14-19, 1975, Las Vegas, Nevada, p 9-1-1 - 9-1-4.

Legal mandates and requirements pertaining to groundwater quality monitoring are reviewed. The Federal Water Pollution Control Act, as amended by Public Law 92-500, and the Safe Drinking Water Act are pieces of federal legislation which dictate needs for groundwater monitoring. A few interstate compacts, such as the federal-interstate compacts for the Delaware River Basin and the Susquehanna River Basin, provide authority for compact commissions to monitor groundwater quality. State laws and regulations for groundwater monitoring show wide variation, and there are generally several state agencies which have statutorily defined authorities and responsibilities with respect to groundwater. At the regional and local levels of government, counties, municipalities and special political jurisdictions such as water supply, sanitary, flood control, and water conservation districts have interests in groundwater quality and often conduct extensive monitoring programs.

*Legal aspects, *Legislation, *Jurisdiction, *Groundwater, *Monitoring, Federal Water Pollution Control Act, Regulation, Water quality

Safe Drinking Water Act, Federal-interstate compacts

J043

ECONOMIC FRAMEWORK FOR GROUNDWATER QUALITY MONITORING,

Crouch, R. L., Eckert, R. D., and Rugg, D. D.

California University,
Santa Barbara,
Department of Economics.

In: International Conference on Environmental Sensing and Assessment, Vol. 1, September 14-19, 1975, Las Vegas, Nevada, p 9-2-1 - 9-2-4. 10 fig, 3 ref.

Economic considerations associated with selecting an optimal groundwater quality compliance monitoring strategy are discussed. Marginal benefits and marginal damage functions are used to analyze a hypothetical situation involving the contamination of a farmer's irrigation well with chlorides from an oil company's unlined brine disposal pit. The marginal cost curve for compliance monitoring will change as technological innovations in the monitoring industry occur and as the relative prices of various alternative monitoring techniques change. Similarly, the marginal benefit curve will change as the marginal social gain from monitoring changes, and this will change as the polluter's marginal benefits function from emitting pollutants and the pollutee's marginal damage function from the impact of pollutants change.

*Monitoring, *Groundwater, *Cost-benefit analysis, *Optimum development plans, Economics, Evaluation, Costs

J044

MONITORING OF SUBSURFACE WASTE-DISPOSAL OPERATIONS: A GENERALIZED SYSTEMS APPROACH WITH EXAMPLES FROM CANADIAN CASE HISTORIES,

Simpson, F.

Windsor University,
Windsor, Ontario, Canada,
Geology Department.

In: International Conference on Environmental Sensing and Assessment, Vol. 1, September 14-19, 1975, Las Vegas, Nevada, p 9-7-1 - 9-7-4. 21 ref.

A systems approach to subsurface waste disposal and monitoring is presented. A typical subsurface-disposal facility is broken down into the following three subsystems: an actuator (the disposal well) through which materials (fluid wastes) and energy (injection pressures and exothermic heat of chemical reactions) are directed into subsurface reservoirs; an injection-affected subsurface space of the disposal interval in which the growing plume of wastes is accommodated through structural adjustment of the aquifer framework and displacement of formation fluids; and a monitoring device which provides a continuous record of both waste behavior in the subsurface environment and the response of the reservoir strata to injection. Monitoring usually takes the form of one or more of the following: wellhead records of injection and annular fluid pressures; shallow and deep observation wells; and geodetic surveys to detect subsidence or increase in strain rate near fracture zones. The current status of monitoring in Canadian subsurface-disposal operations is reviewed with reference to 74 waste-injection facilities initiated to date.

*Waste disposal, *Waste disposal wells, *Injection wells, *Monitoring, *Systems analysis, Wastewater treatment, Chemical reactions, Reservoirs, Aquifers, Equipment, Observation wells, Well data, Canada

J045

POLLUTIONAL EFFECTS OF SUSPENDED, SEDIMENTED AND ERODED PARTICULATE MATERIAL IN THE AQUEOUS ENVIRONMENT,

Hahn, H. H., and Klute, R.

Karlsruhe University,
Karlsruhe, West Germany,
Institut fuer Siedlungswasserwirtschaft.

In: International Conference on Environmental Sensing and Assessment, Vol. 1, September 14-19, 1975, Las Vegas, Nevada, p 14-5-1 - 14-5-10. 6 fig, 1 tab, 25 ref.

The adverse effects of suspended and sedimented particulate matter on aqueous environments are reviewed to illustrate the inadequacy of monitoring for dissolved pollutants only. Suspended particulates are capable of limiting light penetration through natural waters, thus restricting photosynthetic activity. Particulate matter is capable of indirectly affecting water quality through its ability to sorb toxic heavy metals such as cadmium. Processes responsible for the transport and distribution of particulate material include aggregation, sedimentation, erosion, and aggregate destruction; the relative effect of these processes on transport and distribution depends on hydrodynamic and physicochemical factors. A simple mass balance and a dynamic model of the transport and distribution of cadmium in the Neckar River are presented to show that significant amounts of cadmium are transported in forms other than the dissolved form. Cadmium removal is shown to occur as a result of its adsorption on aggregating and sedimenting material, while reactivation is shown to occur via erosion and desorption.

*Suspended solids, *Sediment transport, *Sediment distribution, *Water pollution effects, *Rivers, Model studies, Heavy metals, Toxicity, Photosynthesis, Sorption, Sedimentation, Erosion, Aggregates

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J046

LAND DISPOSAL OF WASTES: POTENTIAL FOR GROUNDWATER POLLUTION,

Carnes, R. A., Brunner, D. R., Landreth, R. E., and Roulier, M. H.

Municipal Environmental Research Laboratory,
Cincinnati, Ohio,
Disposal Branch.

In: International Conference on Environmental Sensing and Assessment, Vol. 1, September 14-19, 1975, Las Vegas, Nevada, p 15-2-1 - 15-2-3. 12 ref.

The potential for groundwater contamination as a result of land disposal of municipal and industrial wastes is discussed. Studies have identified certain geographic regions which are more susceptible than others to groundwater contamination, and case histories of pollutants migrating into surface or groundwater are established. The placement of landfill activities over or near groundwater tables generally poses a definite threat to the water quality of the latter. A shortage of well-documented cases of water pollution resulting from poor land disposal practices appears to be primarily due to a lack of adequate surface and groundwater monitoring. Observation well monitoring systems do not appear to be the most effective means of tracing chemical pollutant flow paths or for determining groundwater chemical concentrations at any time or depth; rather, chemical analysis of core samples from the underlying earth material profile seems to be preferred since it permits a positive definition of any chemical constituent within the profile at any given location.

*Landfills, *Waste disposal, *Groundwater, *Water quality, *Monitoring, Industrial wastes, Municipal wastes, Sanitary engineering, Subsurface waters, Water pollution, Flow

J047
ASSESSMENT OF THE BENEFITS OF ENVIRONMENTAL REMOTE SENSING,

Hershaft, A.

Enviro Control, Incorporated,
Rockville, Maryland.

In: International Conference on Environmental Sensing and Assessment, Vol. 1, September 14-19, 1975, Las Vegas, Nevada, p 16-1-1 - 16-1-6. 1 tab.

Benefits accruing from the use of remote sensing in environmental monitoring are analyzed using a case study designed to assess the benefits of data supplied by a continuing Earth Resources Survey mission in the 1977-1986 time frame. Demand for water quality data is estimated on the basis of the legislative climate, interviews with potential users, and the projected amount of data required. Promising applications in the area of water quality management include: the detection of sediment discharges from non-point sources to assist in establishing waste load allocations in large water bodies, the delineation of dispersion patterns from offshore dumps, and the characterization of long-term trends in sedimentation and eutrophication of large water bodies. Remote sensing also appears to be useful in characterizing hydrologic circulation patterns and in determining water quality trends in large lakes, estuaries, and offshore waters. In general, remote sensing appears to be of value in complementing rather than replacing in situ monitoring data.

*Remote sensing, *Water quality, *Monitoring, *Water management, Analytical techniques, Estuaries, Lakes, Oceans, Coasts, Eutrophication, Surface waters, Water pollution, Sediments, Sedimentation, Waste disposal, Hydrology

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J048
INTERFACIAL CHEMISTRY OF PARTICULATE FLOTATION,

Somasundaran, P.

Columbia University,
New York City, New York,
Henry Krumb School of Mines.

American Institute of Chemical Engineers Symposium Series, Vol. 71, No. 150, p 1-15, 1975. 24 fig, 3 tab, 100 ref.

Basic principles governing particulate flotation are reviewed, with particular emphasis on the interfacial chemistry involved. Although froth flotation is emphasized, precipitate flotation which appears to hold promise for future applications is also discussed. Topics covered include: the classification of flotation techniques on the basis of separation mechanism and size of the material separated, selective hydrophobicity, frothing, flotation activation and depression, flotation deactivation, and the effects of such variables as collector chain length, surfactant chemical structure, collector concentration, solution pH, collector ionic strength, flocculant and dispersant addition, and the conditioning temperature. Techniques for studying the mechanism of particulate flotation are also discussed.

*Flotation, *Chemical properties, *Physical properties, *Water pollution treatment, Separation, Frothing, Flocculation, Treatment

Precipitate flotation

J049
ELECTROCHEMICAL PROPERTIES OF THE OXIDE-SOLUTION INTERFACE IN RELATION TO FLOTATION,

Ahmed, S. M.

Department of Energy, Mines and Resources,
Ottawa, Canada,
Mineral Sciences Division.

American Institute of Chemical Engineers Symposium Series, Vol. 71, No. 150, p 24-33, 1975. 11 fig, 2 tab, 48 ref.

The electrochemical nature of the oxide-solution interface is discussed in relation to the adsorption and flotation properties of oxides. Hydrogen and hydroxyl ions, when adsorbed on oxide surfaces, together constitute a polarizable hydration layer with a hydrogen-bonded structure. For surface behaviors characterized as acidic where the pH range is above the zero point of charge and where there is little or no dissociation, hydrogen and hydroxyl ion activities in the hydration layer are greatly altered due to ion-surface interactions. The corresponding potential drop is attributed to the re-orientation of water dipoles and to the rearrangement of the hydrogen-bonded structure. The surface charge densities are low in this pH range, but the adsorption of neutral organic molecules such as starches and alcohols can be high. As the pH is increased, the double layer becomes strongly ionic due to acidic dissociation of the surface hydroxyl groups; and a further potential drop occurs in the compact layer due specific adsorption of cations. Oxides characterized by a basic surface behavior of dissociation display the converse behavior, and the oxides characterized by amphoteric dissociation display a composite behavior of the above two types, with or without the specific adsorption of anions.

*Flotation, *Adsorption, *Electrochemistry, *Waste treatment, *Oxides, Chemical properties, Electrical properties, Ions, Water pollution control

J050
ION AND PRECIPITATE FLOTATION OF METAL IONS FROM SOLUTION,

Perez, J. W., and Aplan, F. F.

Pennsylvania State University,
University Park,
Mineral Processing Section.

American Institute of Chemical Engineers Symposium Series, Vol. 71, No. 150, p 34-39, 1975. 3 fig, 3 tab, 25 ref.

The processes of ion and precipitate flotation were studied in connection with the removal of copper and iron ions from aqueous solutions. Precipitate flotation proved superior to ion flotation with respect to the amount of surfactant used. Roughly one mole of collector was required for every mole of metal ion removed during ion flotation, whereas only about 1/100 mole of surfactant was required for the removal of a mole of metal ion during precipitate flotation. Metal ion precipitation as sulfides showed the following advantages over precipitation as hydroxides: increased selectivity between species, reduced froth volumes, and the introduction of a broad variety of additional surfactants, especially sulfhydryl compounds which can be used as the collector. A mechanical laboratory flotation cell gave precipitate recoveries similar to those achieved with a foam column; the mechanical cell was also simpler to operate and showed greater potential for the control of foaming and thus froth volume. Breakup of precipitated aggregates was negligible with copper sulfide precipitates and modest for hydroxide precipitates.

*Water purification, *Flotation, *Copper, *Iron, *Ions, Efficiencies, Precipitation intensity, Surfactants, Chemical reactions, Evaluation, Performance, Sulfides, Metals

Hydroxides, Precipitate flotation, Ion flotation

J051

PRECIPITATE FLOTATION OF CALCIUM SULFITE FROM DILUTE AQUEOUS SOLUTION WITH AN ANIONIC SURFACTANT,

Grieves, R. B., Bhattacharyya, D., and Strange, W. T.

Kentucky University,
Lexington,
Department of Chemical Engineering.

American Institute of Chemical Engineers Symposium Series, Vol. 71, No. 150, p 40-45, 1975. 4 fig, 1 tab, 21 ref.

Studies were conducted to assess the feasibility of using precipitate flotation for the treatment of waste streams from wet limestone scrubbing processes used to remove sulfur dioxide from power plant stack gases. The precipitation of calcium sulfite from dilute aqueous solutions (0.0025-0.0105 Molar) at a pH of 8.6 in the presence of calcium sulfate, followed by flotation with the strongly acidic and anionic surfactant sodium dodecylbenzenesulfonate at a feed to sulfite ratio of 0.011 mole/mole resulted in 85% removal of the total sulfite. An increase in the feed calcium to sulfite ratio from 1.0 to 2.0 did not affect the flotation as long as sufficient surfactant was present but did substantially improve the removal of total sulfite due to enhanced precipitation.

*Flotation, *Waste water treatment, *Industrial wastes, *Surfactants, *Sulfite liquors, Separation, Efficiencies, Feasibility studies, Performance, Evaluation, Chemical reactions, Treatment

Precipitate flotation, Calcium sulfite

J052

BEHAVIOR OF HYDROGEN AND HYDROXYL IONS AT THE OXIDE-WATER INTERFACE,

Wakamatsu, T., and Mukai, S.

Kyoto University,
Kyoto, Japan,
Department of Mineral Science and Technology.

American Institute of Chemical Engineers Symposium Series, Vol. 71, No. 150, p 81-87, 1975. 12 fig, 17 ref.

Adsorption isotherms of hydrogen and hydroxyl ions on alumina were determined in the presence and absence of sodium dodecylsulfonate by means of an acid titration method. The pH value at which hydrogen and hydroxyl ions are equally adsorbed onto the alumina, known as the equi-adsorption point, was also determined. Both studies were performed to explain the behavior of such ions in terms of collection and depression mechanisms in flotation. The equi-adsorption point for alumina occurred at a pH value of 7.4, while the isoelectric point for the same material occurred at a pH of 9.0. The equi-adsorption point of alumina did not change even with the addition of dodecylsulfonate. It was also established that the adsorption density of hydrogen ion as well as that of hydroxyl ion on alumina increased with an increase in sulfonate concentration.

*Adsorption, *Flotation, *Waste treatment, *Ions, Hydrogen, Surfactants, Separation techniques, Chemical properties, Performance

Hydroxyl ions, Sodium dodecylsulfonate

J053

CHARACTERIZATION OF ADSORBED COBALT AT THE OXIDE-WATER INTERFACE,

Tewari, P. H., and McIntyre, N. S.

Atomic Energy of Canada Limited,
Pinawa, Manitoba, Canada,
Whiteshell Nuclear Research Establishment.

American Institute of Chemical Engineers Symposium Series, Vol. 71, No. 150, p 134-137, 1975. 5 fig, 1 tab, 7 ref.

The adsorption of cobalt at the oxide-water interface was studied using aluminum oxide and zirconium oxide. The photoelectron line-binding energies for the adsorbed species were compared with those for a number of cobalt oxides and hydroxides to identify the cobalt species adsorbed onto the surface. For cobalt adsorbed from solutions at 30 C, the presence of electronic shake-up associated with the photoelectron lines indicated that the species was paramagnetic and was probably divalent cobalt. Adsorption of divalent cobalt on zirconium oxide and aluminum oxide increased with pH and temperature. Increasing surface coverage by adsorption produced surface precipitation of cobalt hydroxide under conditions that did not cause precipitation in the bulk solution. At higher temperatures the adsorbed cobalt reacted in the substrate to produce compounds like aluminates and spinels. Adsorption of metal ions from aqueous solutions is important to understanding processes involving mineral flotation and water pollution control.

*Adsorption, *Cobalt, *Flotation, *Waste treatment, *Interfaces, *Oxides, Chemical reactions, Metals, Ions, Water pollution control

Aluminum oxide, Zirconium oxide, Oxide-water interfaces

J054

ADSORPTION MECHANISM OF SULFIDES AT A PLATINUM-SOLUTION INTERFACE,

Natarajan, K. A., and Iwasaki, I.

Karnataka Regional Engineering College,
Srinivasnagar, India.

American Institute of Chemical Engineers Symposium Series, Vol. 71, No. 150, p 148-156, 1975. 9 fig, 1 tab, 26 ref.

The behavior of platinum electrodes in the presence of hydrogen sulfide and sulfide ions was studied to provide information on the effects of sulfides on electrochemical measurements used for process control in connection with water and sewage treatment systems as well as flotation processes. In acidic solutions, hydrogen sulfide was a severe poisoning agent, with electrode behavior becoming erratic in its presence. In neutral to alkaline solutions, the presence of sulfide ions in low concentrations did not seriously hamper the electrode response. The mechanism of sulfide adsorption at the platinum solution interface is discussed in relation to various types of potential measurements.

*Electrodes, *Adsorption, *Sulfides, *Hydrogen sulfide, *Interfaces, *Electrochemistry, Analytical techniques, Flotation, Waste water treatment, Sewage treatment, Monitoring

J055
ADVANCES IN INTERFACIAL PHENOMENA OF PARTICULATE/SOLUTION/GAS SYSTEMS; APPLICATIONS TO FLOTATION RESEARCH,

Somasundaran, P., and Grieves, R. B.

American Institute of Chemical Engineers,
New York, New York.

AIChE Symposium Series, Vol. 71, No. 150, 1975, 191 p.

Advances in the area of interfacial phenomena of particulate/solution/gas systems are reviewed along with their application to flotation research. Topics covered include: basic principles of interfaces and solution phenomena; the role of metal ion hydrolysis and the roles of double layers and ion exchange properties of oxide and silicate mineral flotation systems; the application of flotation processes to the removal of precipitated metal ions from aqueous solution, calcium sulfite from scrubber liquor, surfactant additives and suspended solids from desalination solutions, and submicron particulates via high expansion foams; solid/solution/gas properties such as contact angle; solid/solution properties such as adsorption and electrokinetics; and solution/gas properties such as surface tension. The above properties are in most cases correlated with the flotation characteristics of minerals. The flotation chemistry of sulfide mineral systems is also discussed.

*Interfaces, *Flotation, *Waste treatment, *Surfactants, *Adsorption, Chemical properties, Physical properties, Chemical reactions, Suspended solids, Metals, Ions, Sulfites, Desalination, Sulfides

J056
DUMPING SEWAGE SLUDGE IN THE OCEAN,

Environmental Science and Technology, Vol. 10, No. 6, p 530-531, June, 1976. 2 fig.

Shortly after sewage sludge is dumped at the designated New York Bight site, there is very little evidence that the sludge had been dumped. Organic material-rich muds are detected, but they may be composed partly of dredged material (DM), or even material of natural origin, as well as sewage sludge. Most of this material is found in a topographic depression north and west of the sewage sludge dump site, at the head of the Hudson Shelf Valley. By December 1973, sewage sludge dumping (SSD) had become a very controversial issue, the response to which led to greater emphasis on SSD by the New York Bight Project (NYBP) of the Marine EcoSystems Analysis (MESA) Program. The study uses a ship to obtain data on salinity, temperature, turbidity, depth, dissolved oxygen (DO), and pH. Instruments on buoys also provide data on salinity, depth, temperature, and current velocity. The sewage sludge at the New York Bight Apex site consists of about 5% solids and 95% water. It is less dense than water and fractionates and is eddied about rather than sinking as a unit. Nevertheless, adverse effects include fin rot on some fish, exoskeleton erosion and gill clogging on crabs and lobsters, high coli counts, absence of adult surf clams near some dumping sites, decreased DO, high total organic carbon (TOC) and heavy metals concentrations, and evidence of pathogens. The dumping area also receives contaminants from the Hudson River, air pollution fallout, and other waste disposal activities. Since there is no proof satisfactory to public health authorities of a hazard to human health, the National Oceanic and Atmospheric Administration (NOAA) suggests using the existing dump sites until ocean dumping be phased out in 1981.

*Pollutant identification, *Sludge disposal, *Sewage sludge, *Atlantic ocean, Organic matter, Decomposing organic matter, Water pollution sources, Water pollution effects, Waste dumps, Mixing

*New York Bight, *Sewage sludge dumping, New York Bight Project

J057

DATA MANAGEMENT: KEY TO ENVIRONMENTAL QUALITY ASSESSMENT,

Austin, T. S.

National Oceanic and Atmospheric Administration,
Washington, D. C.,
Environmental Data Service.

In: International Conference on Environmental Sensing and Assessment, Vol. 2, September 14-19, 1975, Las Vegas, Nevada, p 25-1-1 - 25-1-4. 1 ref.

An evolving generic concept for an integrated data management system designed for investigating pollution of the marine environment is outlined. The concept incorporates knowledge and experience gained in large-scale, interdisciplinary data collection and interpretation programs such as the Barbados Oceanographic and Meteorological Experiment, the International Field Year for the Great Lakes program, American programs during the International Decade of Ocean Exploration, the Atlantic Tropical Experiment of the Global Atmospheric Research Program, and the development of a National Oceanic and Atmospheric Administration environmental quality monitoring plan for proposed oil and gas activities on the United States Continental Shelf. An international marine pollution monitoring pilot project known as the Integrated Global Ocean Station System is also described. The project involves a cooperative system for the unrestricted international exchange of ocean data, information, and services. Data are collected by 78 participating countries and are transmitted to users through the Global Telecommunications System. The rapidly developing role of remote sensing via satellite is also discussed.

*Data collections, *Data processing, *Data transmission, *Information exchange, *Information retrieval, *Monitoring, Programs, Measurement, Pollutant identification, Remote sensing, Methodology

J058

A PRACTICAL DATA MANAGEMENT SYSTEM FOR MONITORING AND MANAGING LARGE DISTRIBUTED ECOSYSTEMS,

Fisher, P. D., and Cruitt, J. R.

Michigan State University,
East Lansing,
Department of Electrical Engineering and
Systems Science.

In: International Conference on Environmental Sensing and Assessment, Vol. 2, September 14-19, 1975, Las Vegas, Nevada, p 25-5-1 - 25-5-6. 2 fig, 2 tab, 5 ref.

A data management system which has many of the operational characteristics of the Environmental Protection Agency's Water Quality Control Information System is described for the monitoring and managing of large distributed ecosystems such as major watersheds. Data for the system are organized according to date, location, and parameter mnemonic. The system presently contains over 200 defined stations and over 1000 defined parameters. Raw data are being routinely put into the system at a rate of more than 250,000 entries/year. The system includes four possible output format options, including a format suitable for insertion into the Environmental Protection Agency's Water Quality Control Information System. Data are organized and temporarily stored on disc and then periodically moved to magnetic tape. The data management system is well suited for a medium-sized computer facility and for the on-line management of ecosystems in which throughput data delays of not more than 24 hours are required for data collected in situ and 2 weeks for data which must pass through analytical laboratories.

*Data collections, *Data processing, *Information retrieval, *Monitoring, *Watershed management, Computers, Water quality control, Methodology, Pollutant identification

J059

THE ROLE OF ENVIRONMENTAL DATA BANKS IN ENERGY RESOURCE DEVELOPMENT,

Jones, J. E., and Smith, G. E.

Kentucky University,
Lexington,
Institute for Mining and Minerals Research.

In: International Conference on Environmental Sensing and Assessment, Vol. 2, September 14-19, 1975, Las Vegas, Nevada, p 25-6-1 - 25-6-5. 8 tab, 13 ref.

The Environmental Data, Information, and Literature Bank being developed by the University of Kentucky for assessing the environmental, social, and economic aspects of producing clean fuels from coal is described. The data bank is designed to promote information exchange between other related governmental and private projects and the energy development community. Environmental impacts of interest to the environmental data bank include those associated with air, water, noise, and solid waste pollution. Specific data will be collected on surface water and subsurface water contamination and the generation and transfer of heat to water resources. The data bank is viewed as a necessary and integral part of the total energy development program in Kentucky since each coal conversion plant will be required to prepare an environmental impact statement.

*Data collections, *Information retrieval, *Industrial wastes, *Information exchange, *Pollutant identification, Surface waters, Groundwater, Heat, Heat transfer, Energy conversion, Coals, Kentucky

Coal conversion plants

J060

YIELD AND HEAVY METAL CONTENT OF FOOD CROPS GROWN ON SOILS AMENDED WITH SEWAGE SLUDGE,

Bingham, F. T., Mitchell, G. A., Mahler, R. J., and
Page, A. L.

In: International Conference on Environmental Sensing and Assessment, Vol. 2, September 14-19, 1975, Las Vegas, Nevada, p 30-6-1 - 30-6-4. 5 tab, 14 ref.

Wheat and Romaine lettuce were grown in two different soils (calcareous and acidic) treated with a sewage sludge enriched with sulfates of cadmium, copper, nickel, or zinc to test the availability of sludge-borne heavy metals to plants. The zinc, copper, nickel, and cadmium concentrations in wheat grain grown in soil with metal additions ranging from 0-160 micrograms/gram of soil ranged from 73-185, 7.1-11, less than 1.0-119, and less than 0.1-87 micrograms/gram of wheat, respectively. The corresponding values for Romaine lettuce were: 82-1058, 6.2-8.2, 3.5-345, and 1.6-593 micrograms/gram of lettuce, respectively. Cadmium was the most toxic in terms of curtailing crop yields. The pH of the soil also affected the growth of crops and the availability of sludge-borne heavy metals to plant tissue.

*Sewage sludge, *Heavy metals, *Plant growth, *Phytotoxicity, Crop production, Lettuce, Wheat, Cadmium, Zinc, Copper, Nickel, Soils

Land application

J061

FINE PARTICLES AND WATER QUALITY IN THE COASTAL MARINE ENVIRONMENT,

Schubel, J. R.

New York State University,
Stony Brook,
Marine Sciences Research Center.

In: International Conference on Environmental Sensing and Assessment, Vol. 2, September 14-19, 1975, Las Vegas, Nevada, p 34-2-1 - 34-2-11. 5 fig, 3 tab, 48 ref.

The effect of man's activities on the particulate matter loading and water quality of coastal marine environments is discussed. Inputs of naturally-occurring particulate matter to the coastal environment are being increased by land-use practices, dam and reservoir construction, river diversion, and projects to control shore erosion. Anthropogenic particulate matter input is also increasing as well as the local production of organic material as a result of nutrient loading. The increased influxes of particulate matter are significantly reducing the geological lifetimes of many coastal embayments, particularly estuaries. High concentrations of fine-grained suspended matter are degrading some coastal systems to the extent that their useful biological and recreational lifetimes may be cut drastically shorter than their geological lifetimes. Suspended particulate matter is capable of affecting the distribution of dissolved oxygen, decreasing the production of oxygen by rooted aquatic plants, acting as both a source and sink for nutrients, and concentrating various water pollutants. Representative concentrations of total suspended matter are tabulated for various estuarine environments.

*Suspended solids, *Estuaries, *Organic compounds, *Water pollution effects, *Coasts, Aquatic life, Dissolved oxygen, Nutrients, Geology

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J062

QUALITY CONTROL AND HARMONIZATION PROGRAMMES FOR THE ASSESSMENT OF EFFECTS AND THE MEASUREMENT OF ENVIRONMENTAL POLLUTION IN THE EUROPEAN COMMUNITIES,

Recht, P., Smeets, J., Amavis, R., and Berlin, A.

Commission of the European Communities,
Luxembourg,
Health Protection Directorate.

In: International Conference on Environmental Sensing and Assessment, Vol. 2, September 14-19, 1975, Las Vegas, Nevada, p 36-1-1 - 36-1-4. 4 tab.

Quality control and comparative programs dealing with the measurement of environmental pollution throughout the European Communities are discussed. Currently about 450 analytical laboratories are involved in 20 programs involving the collaborative testing of different analytical procedures. A collaborative study on the biological assessment of surface water quality has been initiated to compare the methods of sampling, analysis, and data assessment used by individual laboratories in member states and to aid in establishing possible reference methods. Programs are also being conducted to standardize measurements of microbiological and chemical parameters in drinking water and to develop reliable methods for the determination of cyanides, phenols, and hydrocarbons in surface water.

*Quality control, *Water quality, *Europe, *Programs, *Analytical techniques, Measurement, Evaluation, Surface waters, Potable water, Pollutant identification, Phenols, Sampling, Microbiology, Chemical properties

Phenols, Hydrocarbons, Collaborative testing

J063

VALIDATION OF ENVIRONMENTAL MEASUREMENT METHODOLOGY,

Winter, J. A.

Environmental Protection Agency,
Cincinnati, Ohio,
Environmental Monitoring and Support Laboratory.

In: International Conference on Environmental Sensing and Assessment, Vol. 2, September 14-19, 1975, Las Vegas, Nevada, p 36-5-1 - 36-5-5. 8 fig, 2 tab, 5 ref.

The procedure for validating the Environmental Protection Agency's water and waste water data is described. Formal collaborative studies are conducted among federal, state, industrial, and private laboratories. Samples are prepared in pairs as similar but different concentrates in sealed glass ampuls, and aliquots are added to distilled and natural waste water for subsequent determination by participating laboratories. Differences in the recoveries in these water samples indicate method bias and interferences. Computer programs are used to statistically treat the data and complete the evaluations. The results from these measurements are used to characterize specific analytical methods, to establish precision and accuracy limits for Environmental Protection Agency manuals, and to provide input to formal reports developed by the Agency. Examples of data summaries are provided for the Pyridine-Barbituric Acid Method for total cyanide and cyanide amenable to chlorination in natural waters.

*Quality control, *Water quality, *Analytical techniques, *Evaluation, *Pollutant identification, Measurement, Data processing

Pyridine-barbituric acid method, Cyanide, Environmental Protection Agency

J064

ENVIRONMENTAL ASSESSMENT OF MARINE OUTFALLS,

Hopkins, D. R.

In: Proceedings of the Southeastern Conference on Water Supply and Wastewater in Coastal Areas, April 2-4, 1975, Wilmington, North Carolina, University of North Carolina, p 27-34.

Federal criteria for the issuance of ocean disposal permits for waste outfalls are reviewed along with Environmental Protection Agency studies of the potential impact of ocean outfalls in southeast Florida. The Federal Water Pollution Control Act Amendments of 1972 establish criteria for the issuance of permits for ocean discharges based on the following considerations: the environmental effects of the proposed waste disposal operation, the need for ocean disposal, alternatives to ocean disposal, and the effect of the proposed action on aesthetic, recreational, economic, and other values associated with the ocean. The criteria deal with the evaluation of individual permit applications on a case-by-case basis from information supplied by the applicant concerning the characteristics of the waste and the effect of the waste water on the receiving environment. An Environmental Protection Agency study of alternative waste water disposal methods in southeast Florida concludes that disposal of secondary treated waste water to the ocean via outfalls is a viable method of disposal for the area.

*Waste water disposal, *Outlets, *Permits, *Legislation, *Oceans, *Coasts, *Florida, Atlantic coastal plain, Effluents, Waste water treatment, Legal aspects, Evaluation

Federal Water Pollution Control Act Amendments, Environmental Protection Agency

J065
MANAGEMENT AND FINANCING ALTERNATIVES FOR WASTE
DISPOSAL IN COASTAL AREAS,

Wicker, W. J.

North Carolina University,
Chapel Hill,
Institute of Government.

In: Proceedings of the Southeastern Conference on Water Supply and Wastewater in Coastal Areas, April 2-4, 1975, Wilmington, North Carolina, University of North Carolina, p 35-47. 9 ref.

Alternatives for the management and financing of waste disposal in coastal areas are discussed. The traditional approach to the financing and management of coastal area waste disposal which involves the acceptance of local responsibility by cities and towns appears unlikely to meet present and future needs in many cases, and joint action by county and local governments appears to be needed along with direct state participation in some cases. One mixed possibility involves state financing and local management, with the state prescribing the standards for the entire management structure of the waste disposal operations. Another possibility involves the establishment of separate boards which represent local and state agencies and operate under general state supervision.

*Coasts, *Waste water disposal, *Financing, *Management, Waste disposal, State jurisdiction, State governments, Local governments, Effluents

J066
THE AVAILABILITY OF DESALTING FOR WATER SUPPLY FROM SALINE
SOURCES,

Barnes, W. L., Jr.

U.S. Department of the Interior,
Washington, D. C.,
Office of Water Research and Technology.

In: Proceedings of the Southeastern Conference on Water Supply and Wastewater in Coastal Areas, April 2-4, 1975, Wilmington, North Carolina, University of North Carolina, p 102-110.

A review of the state of the art of various desalination processes is presented. These processes fall into two categories: those involving a phase change such as distillation or crystallization and those which remove salts from water in the liquid phase by such mechanisms as reverse osmosis, electrodialysis, or ion exchange. Distillation processes account for about 93% of all desalination activities throughout the world. Membrane processes, along with ion exchange, are historically the preferred methods for desalting brackish waters, though seawater membrane desalting systems operate at a relatively low product water recovery amounting to about 30%. Eutectic freezing offers a process universally acceptable for all types of saline waste streams and does not require pre-treatment. An additional advantage of the process is its high product recovery which amounts to over 99% of the initial saline water treated. The practicality of desalination is being demonstrated in the southeastern coastal states, particularly Florida, where desalting plants are used to treat brackish water.

*Desalination, *Distillation, *Crystallization, *Reverse osmosis, *Electrodialysis, *Ion exchange, Separation techniques, Desalination processes, Membranes, Brackish water, Saline water, Freezing, Treatment facilities, Coasts, Florida

J067

WASTEWATER REUSE IN COASTAL AREAS,

McJunkin, F. E.

North Carolina University,
Chapel Hill,
Department of Environmental Sciences and Engineering.

In: Proceedings of the Southeastern Conference on Water Supply and Wastewater in Coastal Areas, April 2-4, 1975, Wilmington, North Carolina, University of North Carolina, p 111-123. 2 tab, 7 ref.

Prospects for waste water reuse in the southeastern coastal states are discussed. The potential for direct and indirect waste water reuse is especially high in areas where municipal water supply problems exist. Such areas include the southeastern coastal communities where water demand often exceeds conventional water supplies. Reuse for industrial supply appears to offer the greatest near-term potential for increasing available water resources. One type of reuse often practiced in coastal areas is the return of septic tank effluents or other waste waters to groundwater by percolation through the soil. This leads to the possibility of returning sewage plant effluent, via percolation or well injection, to groundwater aquifers where depletion or salt-water intrusion has occurred. The technology for meeting water standards required by the majority of industrial and agricultural uses is currently available for waste water treatment, and only economics seem to limit increased waste water reuse. Data on industrial users of reclaimed municipal waste water are tabulated along with the status of technology for removing common constituents in waste water.

*Waste water treatment, *Water supply, *Water demand, *Percolation, *Injection wells, *Water reuse, Water utilization, Coasts, Saline water intrusion, Septic tanks, Aquifers, Groundwater, Industrial water

J068

MAN DISCOVERS THE COASTAL ENVIRONMENT: A FOOTPRINT IN THE SAND,

Wallace, J. C.

In: Proceedings of the Southeastern Conference on Water Supply and Wastewater in Coastal Areas, April 2-4, 1975, Wilmington, North Carolina, University of North Carolina, p 133-138.

Poor planning practices and their effects on the southeast coastal environment are reviewed along with some recent improvements in planning. Heavily populated coastal areas without waste water treatment systems as well as areas with overloaded waste treatment systems are cited as examples of inadequate planning. Recent developments in support of more effective planning include the Federal Coastal Zone Management Act, the Federal Water Pollution Control Act Amendments of 1972, and individual actions by states such as the North Carolina Coastal Area Management Act. Some form of federal land use planning is also anticipated in the near future.

*Coasts, *Planning, *Waste water treatment, *Legislation, Land use, Administration, Federal government, State governments, Federal Water Pollution Control Act

J069
FIRST THE WATER, THEN THE SEWER, THEN LAND USE PLANNING:
COASTAL PLANNING IN RETROSPECT AND IN THE NOW,

Hinkley, J. R.

In: Proceedings of the Southeastern Conference on Water Supply and Wastewater in Coastal Areas, April 2-4, 1975, Wilmington, North Carolina, University of North Carolina, p 139-147.

Inadequacies in land use planning along the southeastern coastal area are discussed in relation to water supply and waste treatment problems. A review of residential and industrial strip development along the North Carolina coast reveals that water supply and waste water treatment facilities which were originally designed for limited services are now being overloaded by additional coastal-rural strip developments. Legislation passed by the state's general assembly to insure better land use planning in the future includes the Coastal Area Management Act and the State Land Policy Act. A Coastal Resources Commission and Coastal Resources Advisory Council have been activated to guide the formulation of land use plans in each of the state's 20 counties and their respective municipalities in the coastal area.

*Planning, *Land use, *Coasts, *North Carolina, *Water supply, *Waste water treatment, Treatment facilities, Legislation, Industrial wastes, Domestic wastes

J070
ECONOMIC IMPLICATIONS OF COASTAL WASTE DISPOSAL ALTERNATIVES,

North, R. M.

Georgia University,
Athens,
Institute of Natural Resources.

In: Proceedings of the Southeastern Conference on Water Supply and Wastewater in Coastal Areas, April 2-4, 1975, Wilmington, North Carolina, University of North Carolina, p 148-159. 2 tab, 3 ref.

The economics of alternative waste water disposal systems for coastal areas are evaluated. Economic alternatives are assessed in terms of the degree of water quality desired, the type of institutional arrangements required, and the method of paying for a given water quality level. Estimated costs of alternative waste treatment systems for the Delaware and Potomac Estuaries are calculated and reveal that in each case simple instream reoxygenation can be used to achieve a given level of dissolved oxygen at a cost substantially less than that required for uniform conventional waste water treatment. Failure to implement least cost solutions to waste problems appears to often result from a lack of institutional flexibility and a misallocation of resources.

*Waste water treatment, *Coasts, *Economics, *Economic efficiency, *Cost analysis, Cost allocation, Estuaries, Dissolved oxygen, Oxygenation, Treatment facilities, Administration, Water quality control

J071
PUBLIC PARTICIPATION IN WATER AND WASTEWATER PLANNING,

Dysart III, B. C.

Clemson University,
Clemson, South Carolina,
Water Resources Engineering Graduate Program.

In: Proceedings of the Southeastern Conference on Water Supply and Wastewater in Coastal Areas, April 2-4, 1975, Wilmington, North Carolina, University of North Carolina, p 160-177. 21 ref.

The role of public participation in water supply and waste water treatment planning is discussed. Topics covered include: the impact of various pieces of legislation, including the 1972 Water Pollution Control Amendments, on public participation in waste water planning; the necessity for effective communication between planners, administrators, engineers, and the public; elements essential to a meaningful and effective public participation program; and different levels of public input throughout the process of putting a public facility into operation. Meaningful public participation is viewed as a continuing process, starting at the beginning of a project when the needs for services are being projected, continuing on through the alternative definition and evaluation stage, and finally into the detailed planning and design stage.

*Planning, *Project planning, *Decision making, *Public rights, Water supply, Waste water treatment, Legislation, Legal aspects, Federal Water Pollution Control Act, Communication

Public participation

J072
IMPACT OF WATER SUPPLY AND WASTEWATER ON THE COASTAL AND MARINE ENVIRONMENTS,

Copeland, B. J.

North Carolina University,
Raleigh,
Sea Grant Program.

In: Proceedings of the Southeastern Conference on Water Supply and Wastewater in Coastal Areas, April 2-4, 1975, Wilmington, North Carolina, University of North Carolina, p 178-187.

Water supply and waste water treatment problems associated with southeastern coastal communities are reviewed along with the need for the development of comprehensive community planning. Potential environmental problems are discussed for the following water supply and waste water treatment alternatives: the pumping of fresh water from groundwater supplies, desalination, waste water reuse, the transport of water from other areas, the use of septic tanks, land disposal, deep-well injection, conventional waste water treatment, and the disposal of waste water via ocean outfalls. The recycling of waste water through the water supply system appears to be an optimal choice for solving water problems in the coastal zone. This process also appears capable of eliminating many waste disposal problems. Solids generated by recycling processes might conceivably be used for the generation of methane gas.

*Water supply, *Waste water treatment, *Atlantic coastal plain, *Groundwater availability, *Water reuse, Desalination, Septic tanks, Outlets, Oceans, Injection wells, Recycling, Solid wastes, Methane, Byproducts, Planning, Coasts

J073
EFFICIENCY OF A SEPTIC TILE SYSTEM,

Viraraghavan, T., and Warnock, R. G.

ADI Limited,
Fredericton, New Brunswick, Canada.

Journal Water Pollution Control Federation, Vol. 48, No. 5, p 934-944,
May, 1976. 8 fig, 3 tab, 11 ref.

A field investigation to determine the efficiency of a septic tile system was conducted near Ottawa, Ontario. The test tile was at an average depth of 26 in, and the soil in the area was a mixture of Piedmont (sandy loam texture) and Pontiac (silt loam to silty clay loam texture). The results indicated that the surrounding soil reduced total suspended solids, biochemical oxygen demand, chemical oxygen demand, and soluble organic carbon by 75-90% of their levels in the septic tank. Reductions of phosphates were usually in the 25-50% range, much lower than those reported in the literature. Ammonia reductions ranged between 80 and 90%, and increases in ammonia reduction were generally accompanied by corresponding increases in nitrification. The efficiency of the septic tile system was influenced by seasonal variations, with greater efficiencies (80-90%) being observed in late summer and early fall.

*Tiles, *Tile drainage, *Septic tanks, *Waste water treatment, On-site tests, Efficiencies, Biochemical oxygen demand, Chemical oxygen demand, Suspended solids, Phosphates, Ammonia, Nitrification, Carbon, Organic compounds, Performance

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J074
LEAST COST DESIGN OF ACTIVATED SLUDGE SYSTEMS,

Middleton, A. C., and Lawrence, A. W.

Ottawa University,
Ottawa, Ontario, Canada,
Civil Engineering Department.

Journal Water Pollution Control Federation, Vol. 48, No. 5, p 889-905,
May, 1976. 11 fig, 11 tab, 17 ref.

A comprehensive method for cost optimization of activated sludge waste water treatment systems is presented along with design examples and sensitivity analyses. The method is based on steady-state unit process models and provides preliminary design possibilities that result in minimum system costs for the intended design period. The optimization method is general, and modifications deemed necessary for a particular treatment situation may be incorporated. Additional processes, such as chemical coagulation in primary settling, may be readily incorporated with appropriate costs and sludge production equations. The model indicates that the biological solids retention time may be chosen on the basis of effluent quality goals and process stability without significant cost penalties and that the final settling tank design exerts a significant influence on the optimal liquid treatment design.

*Waste water treatment, *Activated sludge, *Treatment facilities, *Cost analysis, *Optimization, Design criteria, Biological treatment, Retention, Settling basins, Model studies, Equipment

J075

ALTERATION OF MICROBIAL POPULATIONS IN THERMAL STRESS,

Guthrie, R. K., Cherry, D. S., and Singleton, F. L.

Texas University Health Science Center,
Houston,
School of Public Health.

Journal Water Pollution Control Federation, Vol. 48, No. 5, p 962-965,
May, 1976. 3 fig, 7 ref.

The hypothesis that thermal loading to 31 C in waste water effluent to which Flavobacterium lutescens is added increases the die-off rates of Escherichia coli, Streptococcus faecalis, and the enteric pathogen Salmonella typhimurium was tested. In laboratory tests using municipal waste water containing Flavobacterium lutescens and heated to 31 C, Streptococcus faecalis counts remained stable for 2 weeks and then dropped to zero by day 20. Escherichia coli counts remained constant for 1 week and then declined gradually to zero on day 14. Salmonella typhimurium counts remained stable for 2 weeks at 31 C before a rapid decline began, and no colonies were detected by day 30. The results indicate that the use of a naturally occurring aquatic bacterial species in combination with thermal stress offers a potential control of undesirable or pathogenic bacterial contaminants in aquatic systems.

*Waste water treatment, *Biological treatment, *Thermal stress, *Bacteria, *E. coli, Municipal wastes, Pathogenic bacteria, Enteric bacteria, Coliforms, Streptococcus, Salmonella, Evaluation

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J076

EVALUATION OF PFIZER SELECTIVE ENTEROCOCCUS AND KF MEDIA FOR RECOVERY OF FECAL STREPTOCOCCI FROM WATER BY MEMBRANE FILTRATION,

Brodsky, M. H., and Schiemann, D. A.

Ontario Ministry of Health,
Toronto, Ontario, Canada,
Laboratory Services Branch.

Applied and Environmental Microbiology, Vol. 31, No. 5, p 695-699, May, 1976.
3 tab, 16 ref.

Pfizer selective enterococcus and KF agars were compared for their recovery of fecal streptococci from sewage effluent on membrane filters. The KF agar recovered significantly greater numbers of organisms but was not as selective as the Pfizer agar. About 83% of the typical colonies were confirmed as fecal streptococci and 54% as enterococci with the KF agar, and more than 90% of all colonies recovered on membrane filters were confirmed as fecal streptocci and 86% as enterococci with the Pfizer agar. The tan color resulting from esculin hydrolysis, which was not always visible on the surfaces of the colonies, was not considered a necessary differential characteristic on the Pfizer agar. The detection of esculin hydrolysis on membrane filters was not improved by using a new Millipore type HC filter. An attempt to improve the selectivity of KF agar while retaining its inclusiveness by incubation at 45 C was not successful.

*Streptococcus, *Sewage effluents, *Membrane processes, *Analytical techniques, Filters, Microbiology, Bacteria, Microorganisms, Hydrolysis, Evaluation, Performance, Efficiencies

Enterococci, Membrane filtration

J077
LAND APPLICATION OF WASTEWATER,

May, 1975. Newark, Delaware, 98 p. Report PB 241 438.

Papers dealing with the treatment and disposal of waste water by various land application techniques (spray irrigation, overland flow, and infiltration-percolation) are collated in this report. Topics covered include: Environmental Protection Agency policies on land treatment, current land application research, land application practices and design criteria, the public health aspects of land application, educational and informational needs for achieving public acceptance of land application techniques, environmental and sociological impacts of agricultural waste recycling, experience with land application techniques in Pennsylvania's Pennypack Watershed, and the feasibility of using various land application techniques in various geographical areas.

*Waste water treatment, *Waste water disposal, *Recycling, *Irrigation, *Infiltration, *Percolation, *Overland flow, Farm wastes, Administrative agencies, Research and development, Design criteria, Public health, Information exchange, Education, Social aspects

Environmental Protection Agency, Land application

J078
EPA GUIDANCE AND POLICY ON LAND TREATMENT,

Rhett, J. T.

Environmental Protection Agency,
Washington, D. C.,
Office of Water Programs.

In: Land Application of Wastewater, November 20-21, 1974, Newark, Delaware, p 1-2.

Environmental Protection Agency policies on waste water treatment and disposal are reviewed, with particular emphasis on land treatment. An Agency document entitled "Alternative Waste Management Techniques for Best Practicable Waste Treatment" identifies currently known techniques for meeting the requirements of the Water Pollution Control Act Amendments. The choice of which alternative to adopt is left to each municipality or regional sanitary district; however, if an area receives federal funds, it must be guided by the Agency's cost effectiveness regulations. Any land application or land utilization techniques considered must comply with criteria designed to protect groundwaters in order to qualify for federal funding. The deputy administrator of the Environmental Protection Agency has indicated that land treatment may be used in lieu of other systems of waste management if it can be demonstrated land treatment is the most cost effective alternative, is consistent with the environmental assessment, and satisfies applicable tests.

*Waste water treatment, *Waste water disposal, *Federal jurisdiction, *Land use, Legislation, Financing, Economics, Groundwater

Land application, Environmental Protection Agency

J079

PUBLIC HEALTH ASPECTS OF LAND APPLICATION OF WASTEWATER EFFLUENTS,

Sorber, C. A.

Army Medical Bioengineering Research and
Development Laboratory,
Fort Detrick,
Frederick, Maryland.

In: Land Application of Wastewater, November 20-21, 1974, Newark, Delaware, p 27-33. 7 tab, 18 ref.

Waste water treatment involving such land application methods as overland flow, rapid infiltration, and spray irrigation is discussed in terms of its public health impacts. In general, potential health and environmental problems can be minimized by proper waste water treatment and proper site selection. Problems that may be encountered include pathogenic aerosols near spray sites, the enhancement of mosquito breeding at ponding sites, and the presence of sodium and nitrate ions as well as total dissolved solids where waste water recycle is practiced. High sodium contents may be harmful to individuals suffering from cardiac, renal, and circulatory diseases. The nitrate ion is the causative agent of methemoglobinemia in children, and a concentration of no more than 10 mg/liter for nitrate-nitrogen is recommended for drinking water supplies. Pathogens in waste water represent one of the major potential health problems associated with recycling municipal waste water on the land.

*Overland flow, *Infiltration, *Irrigation, *Public health, *Waste water treatment, Pathogenic bacteria, Sodium, Ions, Nitrates, Ponding, Mosquitoes, Diseases, Dissolved solids, Potable water, Municipal wastes, Aerosols

*Land application

J080

EDUCATIONAL AND INFORMATIONAL NEEDS FOR ACHIEVING PUBLIC ACCEPTANCE,

Dunbar, J. O.

Purdue University,
Lafayette, Illinois,
Cooperation Extension Service.

In: Land Application of Wastewater, November 20-21, 1974, Newark, Delaware, p 35-38. 3 ref.

An educational and informational program is proposed for gaining public acceptance of the idea of recycling urban effluents and sludges to the land. The program is outlined in terms of necessary behavioral changes required, educational methods for achieving attitude changes, and means for communicating information on the subject. The program is divided into four parts corresponding to the following types of audiences: the general public, decision makers and others concerned with environment and waste treatment, people with vested interests that will be significantly affected by waste recycling, and professionals from government agencies who work closely with people affected by the decision.

*Waste water disposal, *Sludge disposal, *Recycling, *Information exchange, *Education, *Attitudes, *Waste treatment, Phychological aspects, Political aspects, Social aspects

J081

THE ENVIRONMENTAL AND SOCIOLOGICAL IMPACT OF RECYCLING
OF AGRICULTURAL WASTE BY LAND USE,

Reynolds, B. J.

Green Valley Farms,
Avondale, Pennsylvania.

In: Land Application of Wastewater, November 20-21, 1974, Newark, Delaware,
p 53-57. 2 ref.

The results of an experimental agricultural waste recycling program being conducted at the Green Valley Farms in New Garden Township, Pennsylvania are presented. The basic raw material being recycled is manure effluent discharged by 200 head of milking cows into two stabilization ponds. The effluent is composed of the manure and urine excreted by the animals, wash water for cleaning the concrete pads, and milkhouse and milking parlor wastes. The biologically treated effluent is applied to crops and woodlands by a spray irrigation system. As a result of the growth of the crops and woodlands, the following waste removals are observed: 99.6% of the ammonia in the treated effluent (there is no nitrate in the stabilization ponds), 99.6% of the phosphates, 5-day biochemical oxygen demand, and total as well as fecal coliform. Waste recycling on the farm has resulted in a doubling of corn production, a tripling of soybean production, and large increases in both the tonnage and protein content of grasses. The community response to the land treatment program has been very favorable.

*Irrigation, *Waste treatment, *Recycling, *Waste disposal, *Farm wastes, Stabilization, Ponding, Effluents, Ammonia, Coliforms, Phosphates, Bacteria, Biochemical oxygen demand, Crop production, Social aspects, On-site investigations

Agricultural wastes

J082

EXPERIENCE WITH LAND APPLICATION OF WASTEWATER AND STATE
REGULATIONS - THE PENNYPACK WATERSHED,

Emrich, G. H.

A. W. Martin Associates, Incorporated,
King of Prussia, Pennsylvania.

In: Land Application of Wastewater, November 20-21, 1974, Newark, Delaware,
p 69-63. 6 fig.

The water balance for the Pennypack Watershed is analyzed, and spray irrigation of waste water is concluded to be the most cost-effective waste treatment option for the area. The watershed is capable of accepting up to 4.5 million gallons/day or 1.5 billion gallons/year of treated waste water. This could create a significantly desirable effect on the base flow in the streams and tributaries near the spray areas or could be developed as a groundwater supply. Assuming that 2 in/week of treated waste water (the maximum permitted in Pennsylvania) is spray irrigated onto a site and assuming 80% infiltration, 83 in. of additional water is added to the groundwater reservoir each year. It also is possible to selectively develop water well fields which are contiguous with the spray irrigation fields, thus enabling the recapture of an estimated 50% of the spray irrigated water for public water supply use. The remaining 50% would supplement the base flow in nearby streams.

*Irrigation, *Waste water disposal, *Recycling, *Water management (applied), *Water supply, Groundwater, Surface waters, Watersheds (basins), Wells, Waste treatment, Regulation

Land application

J083

EXPERIENCE WITH LAND APPLICATION OF WASTEWATER AND STATE REGULATIONS - PENNYPACK WATERSHED-PENNSYLVANIA,

Pitcairn, F. U.

Pennypack Watershed Association,
Bryn Athyn, Pennsylvania.

In: Land Application of Wastewater, November 20-21, 1974, Newark, Delaware,
p 65-67. 3 ref.

Water quantity management for the Pennypack Watershed in Pennsylvania is discussed in terms of existing state legislation and the desirability of applying secondarily treated sewage to the land via spray irrigation. The only plan now in existence for the watershed are 10-year plans for sewage facilities in accord with the provisions of the Pennsylvania Sewage Facilities Act. These plans are piecemeal, fragmented attempts to solve short-term problems, with little attention devoted to long-term, regional water management. The Pennypack Watershed Association has identified more than 600 acres of land eminently suited for spray irrigation; these lands could handle up to 4 million gallons/day of secondarily treated sewage. Spray irrigation is capable of recharging the groundwater supply, maintaining the watershed's water balance, augmenting stream flows, minimizing water pollution, and reducing water treatment costs by obviating the necessity for tertiary treatment.

*Irrigation, *Water management (applied), *Waste water disposal, *Sewage treatment, *Recycling, *Water supply, Groundwater, Surface waters, Watersheds (basins), Waste water treatment, Costs, Regulation, Legislation, Land use, Regional development

Land application

J084

LAND DISPOSAL OF WASTEWATER IN THE COMMONWEALTH OF PENNSYLVANIA - A REGULATORY VIEW,

Curran, S. F., Jr.

Pennsylvania Department of Environmental Resources,
Bureau of Water Quality Management,
Ground Water Section.

In: Land Application of Wastewater, November 20-21, 1974, Newark, Delaware,
p 69-70. 3 ref.

Waste water disposal via spray irrigation in the Commonwealth of Pennsylvania is discussed from a regulatory point of view. Since large amounts of waste water discharged to the land surface infiltrate and recharge groundwater, all spray irrigation installations in Pennsylvania are considered as discharges to the waters. Spray irrigation should be used only in situations where the waste water contains materials that can be renovated in the soil mantle and do not pollute groundwater. Generally, the equivalent of secondary treatment must precede the irrigation. The Pennsylvania Department of Environmental Resources makes allowances for variability of earth materials, spray field use, and effluent constituents in reviewing installation proposals on a site by site basis. The prime consideration for site selection is the ability of the organic and earth materials to properly treat the waste water.

*Irrigation, *Waste water disposal, *Waste water treatment, *Recycling, *Regulation, *State jurisdiction, Pennsylvania, Water management (applied), Sites, Groundwater, Treatment

Land application

J085
ANNUAL CONFERENCE PROCEEDINGS OF THE ONTARIO SECTION OF THE AMERICAN WATER WORKS ASSOCIATION, POLLUTION CONTROL ASSOCIATION OF ONTARIO, AND ONTARIO MUNICIPAL WATER ASSOCIATION,

April 20-23, 1975, Toronto, Ontario, 433 p.

Papers dealing with the treatment and disposal of wastes and their effects on the water environment are discussed. Specific subjects covered include: chlorine toxicity to fish, hazards associated with viral contamination of waters, computer programs for planning the regional disposal of municipal sludge, the effect of urban development on drainage patterns, the role of environmental assessment in land use planning, legislation for preserving the water quality of the Great Lakes, methods for the disinfection of potable water supplies, techniques for monitoring and controlling fluoride residuals in drinking water supplies, the feasibility of using ferric chloride as a substitute for alum during water treatment operations, design criteria for water supply and waste water treatment systems subject to topographical and climatic constraints, management practices for maintaining water works equipment in proper condition, safety practices and training programs for operators in water treatment facilities, and methods for the ultimate disposal of wastes generated by water purification facilities.

*Conferences, *Waste water treatment, *Water supply, *Water pollution effects, *Water purification, *Waste disposal

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J086
DISINFECTION, DECHLORINATION AND TOXICITY TO FISH,

Servizi, J. A., and Martens, D. W.

International Pacific Salmon Fisheries Commission,
Cultus Lake, British Columbia, Canada,
Sweltzer Creek Salmon Research Laboratory.

In: Annual Conference Proceedings of the Ontario Section of the American Water Works Association, Pollution Control Association of Ontario, and Ontario Municipal Water Association, April 20-23, 1975, Toronto, Ontario, p 34-44. 4 tab, 18 ref.

Studies on chlorine toxicity to fish are reviewed, with particular emphasis on the effect of chlorine disinfection during primary sewage treatment. Continuous flow bioassays on sockeye salmon fingerlings exposed to various dilutions of sewage before and after chlorination revealed that chlorine residuals sufficient to meet disinfection criteria substantially increased the toxicity of the primary effluent. A chlorine concentration of 25% (by volume) in the primary effluent generally resulted in the death of juvenile sockeye within about 96 hours. Chlorination caused a decrease in the average mean survival time from 293 minutes to 32 minutes. Dechlorination using sulfur dioxide brought the mean survival time from 32 minutes up to 434 minutes. Although a comparison of the mean survival times of primary and dechlorinated sewage suggests that the process of chlorination-dechlorination removes more toxicity than that caused by chlorine addition alone, the result is of limited practical significance since the lowest concentration at which mortalities occurred was the same (17% by volume) for both effluents.

*Chlorination, *Toxicity, *Mortality, *Sewage treatment, *Sockeye salmon, Bioassay, Treatment facilities, Fish, Sewage treatment effluents

Dechlorination

J087
VIRAL CONTAMINATION OF THE WATER ENVIRONMENT, AN UNDERESTIMATED PROBLEM,

Mahdy, M. S.

Canada Centre for Inland Waters,
Burlington, Ontario,
Scientific Operations Division.

In: Annual Conference Proceedings of the Ontario Section of the American Water Works Association, Pollution Control Association of Ontario, and Ontario Municipal Water Association, April 20-23, 1975, Toronto, Ontario, p 45-64. 1 fig, 7 tab, 31 ref.

Potential hazards associated with viral contamination of the water environment are discussed. Human viruses shed in the feces and urine have been repeatedly detected in sewage, effluents, and water bodies receiving effluent streams; their presence appears to be due to incomplete inactivation during sewage and water treatment. Viruses that are shed in the feces and/or urine of man include the entero-, adeno-, reo-, cytomegalo, and orbi-viruses as well as hepatitis. With the exception of three types of polioviruses, there are no vaccines available for use by potentially exposed populations. Virus removals in waste water treatment may range from 50-99.9%, depending on the type of treatment. The relatively long survival times of viruses combined with the fact that very small amounts of viruses are capable of infecting a susceptible host suggest the need for increased emphasis on evaluating the types of viruses circulating in communities and the efficiency of sewage treatment techniques.

*Viruses, *Sewage treatment, *Public health, *Water quality, Water pollution effects, Urine, Waste water treatment, Infection, Microorganisms, Aquatic microbiology, Diseases

Feces, Human wastes

J088
OPERATOR TRAINING AND CERTIFICATION IN CANADA,

Redekopp, A. B.

In: Annual Conference Proceedings of the Ontario Section of the American Water Works Association, Pollution Control Association of Ontario, and Ontario Municipal Water Association, April 20-23, 1975, Toronto, Ontario, p 348-362. 3 tab, 7 ref.

The status of training and certification programs for waste water and water treatment plant operators in Canada is reviewed. Voluntary certification programs have been established by four provinces to date: British Columbia, Alberta, Saskatchewan, and Manitoba. The Federation of Associations of the Canadian Environment is currently developing nationally acceptable guidelines for operator certification and is considering approaches to assist the provinces in operator training. Current training efforts in Canada cover, for the most part, the general knowledge area of water and waste water treatment operations through seminars or short courses provided by the provincial regulatory agencies and/or local operator associations. The Federal Department of the Environment, however, is currently assisting the three Maritime Provinces in the development of a comprehensive training program for waste water treatment operators which is based on a performance oriented approach to learning.

*Training, *Treatment facilities, *Personnel, *Education, *Canada, Water treatment, Waste water treatment, Programs, Organizations, Operations

Certification

J089

TRAINING AND CERTIFICATION,

Doddridge, R. R.

Ontario Ministry of the Environment,
Toronto, Ontario, Canada,
Training, Certification and Safety Section.

In: Annual Conference Proceedings of the Ontario Section of the American Water Works Association, Pollution Control Association of Ontario, and Ontario Municipal Water Association, April 20-23, 1975, Toronto, Ontario, p 363-374. 1 fig, 4 tab, 2 ref.

Progress in the training and certification of water and waste water treatment plant operators in Ontario is reviewed. Training programs for water and waste water facility operators have been provided in Ontario for a number of years, with the Ontario Water Resources Commission offering annual courses at the basic, intermediate, and advanced levels. The Ontario Ministry of the Environment has proposed a 4-year program leading to mandatory certification. The development of the program was initiated in 1973 and 1974. The initial program consisted of the following elements: a basic water treatment course, a basic sewage treatment course, a basic gas chlorination workshop, and an activated sludge workshop. In 1974 and 1975 the subject areas were expanded to include a surface water treatment workshop and a maintenance gas fitter certificate course. Further expansion is scheduled for 1975 and 1976 and is expected to include a primary treatment and digestion workshop, a preventive maintenance workshop, a pumping operation workshop, and safety and first aid training.

*Training, *Treatment facilities, *Personnel, *Education, *Canada, Water treatment, Waste water treatment, Programs, Organizations, Operations

Certification, Ontario

J090

NORTHERN ENVIRONMENTAL ENGINEERING - A CANADIAN CHALLENGE,

Dawson, R. N., and Slupsky, J. W.

Stanley and Associates Engineering Limited,
Edmonton, Alberta, Canada

In: Annual Conference Proceedings of the Ontario Section of the American Water Works Association, Pollution Control Association of Ontario and Ontario Municipal Water Association, April 20-23, 1975, Toronto, Ontario, p 376-402. 7 tab, 13 ref.

Research programs dealing with water supply and waste disposal in the Northwest Territories of Canada are reviewed. Studies currently being conducted include: the feasibility of using vacuum toilets and incineration for the disposal of human wastes at construction campsites; the economics and operating problems associated with trailer-mounted physical-chemical sewage treatment systems; the suitability of rotating biological contactors for treating workcamp waste water; the determination of virus removal rates from waste waters generated by current treatment methods; the use of steady state computer models for predicting subsidence and temperature profiles in oxidation lagoon berms located in permafrost soils; the fate of human wastes which are dumped into pits in arctic areas; the effect of buried pipelines on permafrost thawing; and, the practicability and efficiency of long retention lagoons used for waste water treatment at high latitudes. Special attention is being devoted to the adverse weather and terrain conditions of the Northwest Territories which result in a more fragile ecology and the need for a better understanding of the impact of waste disposal practices.

*Waste treatment, *Water supply, *Climates, *Topography, *Canada, *Water pollution effects, Sewage treatment, Waste water treatment, Viruses, Model studies, Computer programs, Temperature, Permafrost, Incineration, Biological treatment, Pipelines, Oxidation lagoons, Research and development, Programs

Northwest Territories

J091
SAFETY IN WATER AND WASTEWATER PLANTS,

Norton, R.

In: Annual Conference Proceedings of the Ontario Section of the American Water Works Association, Pollution Control Association of Ontario, and Ontario Municipal Water Association, April 20-23, 1975, Toronto, Ontario, p 326-331.

The development of safety programs for water and waste water treatment plants is discussed, with particular emphasis on employer-employee responsibilities. The employer's responsibility centers around gaining the interest and cooperation of employees, with emphasis on preventive safety measures during daily operational activities. Employees in turn can assist management in the development of a preventive safety program and can alert the employer when unsafe conditions exist. Hazardous areas and activities encountered in water and waste water treatment operations include: enclosed spaces such as sewer manholes and watermain valve pits, digester control buildings where methane leaks are possible, chlorination rooms, and activities involving the handling of water treatment chemicals and the dismantling of water treatment equipment. The use of personal protective equipment in hazardous areas is also discussed.

*Safety, *Treatment facilities, *Water treatment, *Waste water treatment, *Protection, Chemicals, Personnel, Programs, Management, Equipment

J092
CONSTRUCTION SAFETY IN WATERWORKS,

McKnight, C. E.

Construction Safety Association of
Ontario,
Toronto, Ontario, Canada.

In: Annual Conference Proceedings of the Ontario Section of the American Water Works Association, Pollution Control Association of Ontario, and Ontario Municipal Water Association, April 20-23, 1975, Toronto, Ontario, p 321-325.

Measures being taken in Ontario, Canada, to promote safety during the construction of water works are reviewed. The Construction Safety Act of 1973 governs all installation, rennovation, and repair activities except those covered by the Mining Act. The Act specifies personal protective equipment that must be worn by workers on any project that changes the physical structure or appearance of a building, equipment, or machinery. The Construction Safety Association of Ontario provides area counselors who actively promote accident prevention and develop educational programs for contractors and their employees. The Research and Development Section of the Association investigates accident causes and provides statistical information on accident occurrence.

*Safety, *Accidents, *Construction, *Treatment facilities, *Water treatment, Education, Legislation, Organizations, Canada

Ontario, Construction safety act

J093
ENVIRONMENTAL ASSESSMENT: A PLANNING TOOL,

Plewes, M. E.

In: Annual Conference Proceedings of the Ontario Section of the American Water Works Association, Pollution Control Association of Ontario, and Ontario Municipal Water Association, April 20-23, 1975, Toronto, Ontario, p 154-160.

The use of environmental assessment as a planning tool is discussed along with the development of Ontario's Environmental Assessment Act. The need for environmental assessment in Ontario has become apparent as a result of increased public interest in the environmental impacts of large-scale projects involving river diversions, sewage treatment plants, sewers, pieplines, and other construction activities. Recently, there has been a gradual shift in emphasis away from after-the-fact controls and towards restorative and preventive measures by environmental protection organizations in Ontario. The Environmental Assessment Act is an example of this change in emphasis. The Act requires proponents of designated undertakings to submit to the Minister of the Environment an environmental assessment of the project which must be accepted by the Minister prior to project initiation.

*Planning, *Environmental effects, *Legislation, *Canada, *Legal aspects, *Assessments, Evaluation, Environmental control, Construction, Project planning

Environmental impact statements, Ontario, Environmental Assessment Act

J094
THE GREAT LAKES AGREEMENT - A MID-TERM PERSPECTIVE,

Robinson, R. M.

Environment Canada,
Ottawa, Ontario,
Liaison and Coordination Directorate.

In: Annual Conference Proceedings of the Ontario Section of the American Water Works Association, Pollution Control Association of Ontario, and Ontario Municipal Water Association, April 20-23, 1975, Toronto, Ontario, p 161-178.

The development and implementation of the Great Lakes Water Quality Agreement of 1972 is reviewed. The agreement which sets out objectives and commitments of the United States and Canada regarding the protection of the water quality of the Great Lakes also identifies programs needed to achieve these objectives, establishes institutional mechanisms required to make the agreement as self-policing as possible, and creates a constant review process. An International Joint Commission is responsible for monitoring the progress on both sides and for reporting the results to the governments as well as the public. Canadian programs for installing municipal waste treatment facilities and controlling nutrient inputs are currently near to meeting the goals established in 1972. Significant progress is also being made by the United States, although adequate municipal waste treatment facilities presently serve only 60% of the sewered population on the United States side. This figure is expected to rise to 95% by 1978.

*Legislation, *Great Lakes, *Water pollution control, *Canada, *United States, Municipal wastes, Legal aspects, Waste treatment, Nutrients, Surface waters, International Joint Commission, Water law, Monitoring, Institutions

Great Lakes Water Quality Agreement

J095

REVIEW OF STANDARDS AND OTHER INFORMATION ON THERMOPLASTIC PIPING IN RESIDENTIAL PLUMBING,

Wyly, R. S., Parker, W. J., Rorrer, D. E., Shaver, J. R., and
Sherlin, G. C.

Department of Commerce,
Washington, D. C.,
National Bureau of Standards.

May, 1975. 65 p, 1 fig, 10 tab, 56 ref, 1 append. Building Science Series No. 68.

Existing information on the physical characteristics of thermoplastic piping of particular interest for its use in residential, above-ground plumbing are reviewed. Adequacy of functional performance of plumbing systems is considered from the user's viewpoint. Thin-wall poly(vinyl chloride) (PVC) drain-waste-vent systems and tube-size chlorinated poly(vinyl chloride) (CPVC) water-distribution piping in particular were studied. Acrylonitrile-butadiene-styrene (ABS) is also widely used for water distribution and drain, waste, and vent systems (DWV). The principal issues involving thermoplastics piping for above-ground plumbing include potential fire hazards, effects of hot water, potential for chemically induced cracking, effects of hydrostatic pressure and water hammer, adequacy of acoustical performance, and ability to assure critical design and installation details through routine inspection. Where thermoplastics piping is approved, there are often restrictions, including type of waste, fire rating of the building, pipe wall thickness, and height. Performance of ABS and PVC drain-waste-vent piping apparently depends to a significant degree on installation and design details.

*Plastic pipes, *Drains, *Plumbing, *Water conveyance, *Plastics, Performance, Burning, Heat resistance, Thermal properties

J096

MERCURY IN LAUNDRY WASTEWATERS,

Patterson, J. W.

Illinois Institute for Environmental Quality,
Chicago, Illinois.

February, 1975. 45 p, 22 tab, 106 ref. IIEC Doc. No. 75-10.

Results of a study directed toward identifying sources of mercury in laundry are described, and the capability and technological feasibility of available mercury abatement procedures for laundry wastes are assessed. Perhaps half or more of the mercury in laundry waste water was removed from soiled fabrics during laundering. The other major source of mercury in laundry waste water is mercury contaminated laundering chemicals. Significant mercury content was indicated for caustic, hydroflurosilicic acid, bacteriostats and mildicides, and various soaps and fabric softeners which frequently contain bacteriostatic agents. Iron and calcium chloride coagulation and activated carbon adsorption have the capability to treat effluent to meet the Illinois effluent standard of 0.5 microgram/liter. Only activated carbon, however, would consistently achieve an effluent value below the Illinois standard for the mercury levels in commercial laundry waste water. It has been shown to reduce mercury levels to below 0.25 micrograms/liter on a commercial laundry waste. Mercury abatement by substituting mercury-free laundering chemicals is also possible. Laundering chemicals can also be pretreated to remove mercury before use. Filtering caustic prior to use could possibly reduce mercury in the waste water by as much as 40%.

*Waste water treatment, *Mercury, *Laundering, *Waste water (pollution), *Pollution abatement, Detergents, Fabrics, Chemicals, Adsorption, Activated carbon, Standards, Filtration

J097

ODOUR CONTROL AT TORONTO'S ASHBRIDGES BAY TREATMENT PLANT,

Water and Pollution Control, Vol. 114, No. 6, p 40-41, June, 1976. 1 fig.

Odor control facilities are being installed in three municipal sewage treatment plants in Toronto. Major sources of the odors at the Main Treatment Plant, Ashbridge Bay, were found to be the aeration tanks, multi-hearth incinerators, aerated grit tanks and screens, and primary tanks. The aeration tank odors, consisting of normal spent diffused air plus ventilated air from the covered primary tanks, will be eliminated by ozonation, followed by wet scrubbing. With this sytem, any odors not oxidized by ozonation will be oxidized in the cross flow scrubbers. The level of ozone in the discharged air, after scrubbing, will be below the 0.08 ppm limits required by law. A detailed description of the system is provided, including the axial fans to discharge emission air, measurement instrumentation for ozone pressure and concentration, and process automation facilities.

*Waste water treatment, *Sewage treatment, *Treatment facilities, *Odor, *Control, Incineration, Screens, Ozone, Oxidation

Aeration tanks, Aerated grit tanks, Primary tanks, Scrubbers

J098

WATER POLLUTION CONTROL: CROSSROADS OF A MUNICIPAL FINANCIAL DILEMMA,

Williams, F. P., and Rucks, A. C.

North Texas State University,
Denton,
Department of Administrative Sciences and Marketing.

Public Works, Vol. 107, No. 6, p 86-88, June, 1976. 1 fig, 1 tab, 21 ref.

Financial and economic considerations are needed in environmental decision making. This discussion includes the amount of financing required by municipalities, the goals of the Water Pollution Control Act Amendments of 1972, some alternative financial resources available to municipalities, and the need for careful evaluation of these alternatives. The Environmental Protection Agency (EPA) estimated, via the 1974 'Needs Survey,' that municipalities will require an investment of $114.6 billion in waste treatment facilities to accomodate urban populations in 1990. The per capita costs were estimated at $549 in 1972 and $464 in 1990. Adjusted estimates are $1,500 per capita in 1972 and $1,265 per capita in 1990. The traditional methods of financing municipal projects such as waste water treatment include property taxes, user charges, special assessments, and bond issues. The EPA also provides waste treatment construction grants. Cities have encountered difficulties, however, in obtaining these funds. It has also been reported that some states are penalized with respect to funds because their cities have been more effective than others in applying advanced waste treatment technology. The effects on individual cities of alternative forms of financing should be analyzed. The analysis should include cost estimates for achieving national water quality goals, an appraisal of the ability of internal sources of funds to meet these costs and the extent to which external sources will be needed, and an appraisal of the per capita impact of using alternative sources of funds.

*Waste water treatment, *Treatment facilities, *Analytical techniques, *Water pollution

J099

WATER UTILITY PROCESSING SYSTEM (WUPS) APPLICATION
COMPLETION REPORT VOLUME I,

June, 1975. 789 p, 14 fig, 9 append. Technical Report PB-247 781.

An Urban Information Systems Inter-Agency Committee (USAC) Project in Wichita Falls, Texas, applies computer use to the full range of municipal functions. It is divided into several systems, including the Water Utility Processing System (WUPS), designed to support Wichita Falls in selling its water resources with associated services. The system is designed to provide for determining the cost of refuse, water, sewer, and assessment services, billing each customer, and collecting payment on the accounts. The hardware for the system includes an International Business Machines (IBM) 370/145 computer, storage devices, five tape drives, a reader/punch, 19 video terminal devices, and a cartridge reader. The software consists of IBM's Disk Operating System/Virtual Storage (DOS/VS), IBM's Customer Information Control System (CICS) for telecommunications, and a spooling system.

*Local governments, *Cost-Benefit analysis, *Documentation, *Cities, *Municipal water, Sewerage, Computers, Water resources

*Information systems, *Urban Information Systems Interagency Committee, *Wichita Falls, *Total system, *Water Utility Processing System

J100

WATER UTILITY PROCESSING SYSTEM (WUPS) APPLICATION COMPLETION
REPORT VOLUME II,

June, 1975. 433 p, 34 fig, 79 tab. Technical Report PB-247 782.

An Urban Information Systems Inter-Agency Committee (USAC) Project in Wichita Falls, Texas, applies computer use to the full range of municipal functions. It includes the Water Utility Processing System (WUPS), which supports Wichita Falls in selling its water resources with associated services. The purpose of the system is determining the cost of refuse, water, sewer, and assessment services, billing each customer, and collecting payment on the accounts. Volume II contains the appendix on User Department procedures, which completes the description of this system. It contains procedures describing processes performed by User Department personnel for the functions developed for the system. The hardware for the system includes an International Business Machines (IBM) 370/145 computer, storage devices, five tape drives, a reader/punch, 19 video terminal devices, and a cartridge reader. The software consists of IBM's Disk Operating System/Virtual Storage (DOS/VS), IBM's Customer Information Control System (CICS) for telecommunications, and a spooling system.

*Local governments, *Cost-Benefit analysis, *Documentation, *Cities, *Municipal water, Sewerage, Computers, Water resources

*Information systems, *Urban Information Systems Interagency Committee, *Wichita Falls, *Total system, *Water Utility Processing System

J101
BENEFICIAL USE OF INDUSTRIAL WASTES IN MUNICIPAL
WASTEWATER TREATMENT PLANTS,

Wilson, T. E.

Greeley and Hansen, Engineers,
Chicago, Illinois.

In: 3rd National Conference on Complete WateReuse, June 27-30, 1976, Cincinnati, Ohio, p 594-598. 3 fig, 3 tab, 14 ref.

Industrial wastes which can be used for beneficial purposes in municipal waste water treatment plants are discussed. Metal-acid wastes from industrial operations can be used for phosphorus removal, sludge conditioning, and a general improvement in suspended solids removal and biochemical oxygen demand removal in municipal waste water treatment operations. In general, the metal-acid waste should have a relatively high iron or aluminum content (about 5 and 2.5%, respectively). High concentrations of heavy metals in metal-acid wastes, however, may render these wastes unsuitable for the above purposes. High strength organic industrial wastes can be used to replace expensive raw chemicals used in biological denitrification processes. The organic waste should be preferably concentrated, with a soluble chemical oxygen demand as high as possible (over 50,000 mg/liter). The organic waste must also contain very little nitrogen. Specific examples of the use of each type of waste in waste water treatment applications are cited.

*Industrial wastes, *Waste water treatment, *Organic compounds, *Metals, *Acids, Sludge treatment, Suspended solids, Biochemical oxygen demand, Heavy metals, Biological treatment, Denitrification, Chemical oxygen demand, Nitrogen, Byproducts, Treatment facilities, Phosphorus

Municipal-industrial wastes

J102
IRRIGATION OF LEASED FARMLAND WITH TREATED WASTEWATER,

Wenck, N. C., Hannaman, M. C., and Roskopf, R. F.

Eugene A. Hickok and Associates,
Wayzata, Minnesota.

In: 3rd National Conference on Complete WateReuse, June 27-30, 1976, Cincinnati, Ohio, p 578-593. 13 fig, 13 tab.

The results from a one-year pilot study involving the irrigation of farmland with treated waste water are presented. A total of 8.2 inches of waste water was applied to the study site in six different irrigation runs, and crop samples were obtained from both irrigated and nonirrigated areas. The irrigation resulted in an increase in corn yield of 28 bushels/acre. Based on soil moisture and consumption use data, a design application rate of 12 inches/year appears feasible. The irrigations did not affect groundwater levels in the area; and with the exception of chlorides, no changes in groundwater quality were detected. Chloride contamination did not appear to be serious. No complaints of odor were received from surrounding residents during the irrigation season.

*Water reuse, *Waste water, *Irrigation, *Farms, *Recycling, Crop production, Groundwater, Water quality, Water conservation, Odor, Evaluation, Chlorides

J103

DEVELOPMENT OF INSTRUMENTATION FOR A WATER PROCESSING ELEMENT,

See, G. G., Yang, P. Y., and Wynveen, R. A.

Life Systems, Incorporated,
Cleveland, Ohio.

In: 3rd National Conference on Complete WateReuse, June 27-30, 1976, Cincinnati, Ohio, p 491-501. 15 fig, 4 tab, 5 ref.

A water processing element designed for use with transportable Army hospitals is described, with particular emphasis on the instrumentation aspects of the system. The water processing element is capable of treating and disposing hospital waste water, producing water for reuse from waste water, and desalting brackish water for potable uses. The unit consists of six separate processes with control and monitoring instrumentation: equalization/prescreening, ultrafiltration, ion exchange, reverse osmosis, ozone oxidation, and hypochlorination. A discussion of instrumentation developments and approaches to the design of instrumentation is presented along with an example of the detailed instrumentation design of the ozone oxidation unit process.

*Waste water treatment, *Water reuse, *Desalination, *Instrumentation, *Equipment, Reverse osmosis, Ozone, Chlorination, Oxidation, Filtration, Ion exchange, Design criteria, Potable water, Brackish water, Monitoring, Control systems

J104

SOURCES AND POTENTIAL USES OF SALVAGEABLE WATERS IN ARIZONA URBAN REGIONS,

DeCook, K. J.

Arizona University, Tucson,
Water Resources Research Center.

In: 3rd National Conference on Complete WateReuse, June 27-30, 1976, Cincinnati, Ohio, p 310-319. 5 tab, 12 ref.

Symbiotic relationships which are implicit in the occurrence and potential use of salvageable waters in the desert urban environments of Phoenix and Tucson, Arizona are discussed. Treated sewage effluent can be used for crop irrigation and as a source of nitrogen for cropped lands. Satellite waste water treatment plants located in urban regional parks can relieve local overloading of the sewage collection systems and simultaneously provide a source of usable water to supplement park water requirements. Power plant blowdown can be used for groundwater recharge and irrigation of landscaped areas. The diversion of short-term peak flood flows from small urban watersheds can reduce flood danger as well as the construction cost of hydraulic structures downstream while providing supplementary water supplies for turf irrigation or recreation parks adjoining the watercourse.

*Water reuse, *Reclaimed water, *Water management (applied), *Cities, *Deserts, Groundwater recharge, Floodproofing, Surface waters, Irrigation, Sewage treatment, Fertilizers, Nutrients, Nitrogen, Industrial wastes, Recreation facilities, Arizona

J105
LOWER WALLER CREEK MASTER IMPROVEMENT PLAN,

Shefelman, T. W., and Ullrich, A. H.

Taniguchi, Shefelman, Vackar, Minter,
Austin, Texas.

In: 3rd National Conference on Complete WateReuse, June 27-30, 1976, Cincinnati, Ohio, p 305-309.

A plan for improving the flow and flooding characteristics as well as water quality is proposed for lower Waller Creek which runs through the economically depressed eastern edge of the central business district in Austin, Texas. Methods being considered for supplementing flow include: drilling wells in the drainage area and discharging pumped groundwater into the channel, pumping town lake water to some upstream point and discharging it into the channel, and operating the existing municipal swimming pools in the drainage area on a flow-through basis for discharge into the creek channel. Concepts for flood control being considered include: upstream flood retarding structures, channel modifications, relocations of man-made obstacles, and flood water bypasses around bridges and possibly other channel restrictions. Plans for improving the water quality include: storm water treatment; dry weather flow water treatment; the monitoring of flows from storm sewers, gutters, and surface drains; and the pumping of town lake water for discharge into the creek at upstream points. Land use and development plans for the area are also being considered.

*Water management (applied), *Floodproofing, *Waste water treatment, *Streams, *Cities, Surface waters, Groundwater, Monitoring, Land use, Texas, Planning

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J106
PROJECT CURE,

Stephan, D. G.

In: 3rd National Conference on Complete WateReuse, June 27-30, 1976, Cincinnati, Ohio, p 286-289. 1 tab, 3 ref.

Project CURE (Clean Urban River Environments), a research proposal prepared in 1969 jointly by the Mid-Continent region of the Bureau of Outdoor Recreation and the Missouri Basin of the Federal Water Pollution Control Administration, is described. The proposed project involves the advanced treatment of waste water very near its points of use and collection followed by releases of the highly treated effluent into either natural or specially created channels and impoundments. The objective of the project is to create newly-formed rivers and lakes for water-oriented outdoor recreation and for the enhancement of the urban environment. Treatment plants are expected to be relatively small and located in or near homogeneous suburban areas at the fringes of the city. The additional costs associated with the construction of such treatment facilities are expected to be somewhat offset by the fact that extensive sewers will be unnecessary. Existing sewers could be utilized for transporting storm water runoff, and existing treatment plants could likewise be used for treating storm water runoff, thus increasing the overall quality of treated water.

*Waste water treatment, *Tertiary treatment, *Surface waters, *Water management (applied), *Reclamation, *Recreation facilities, *Rivers, Channels, Lakes, Impounded waters, Artificial watercourses

Project CURE

J107

TRANSPORT OF CONCENTRATES AND SLUDGES,

Ettlich, W. F.

Culp/Wesner/Culp - Clean Water Consultants,
El Dorado Hills, California.

In: 3rd National Conference on Complete WateReuse, June 27-30, 1976, Cincinnati, Ohio, p 140-146. 11 fig, 3 tab.

A cost analysis of various sludge transport methods is presented. The total annual cost for the transport of dewatered sludge by railroad is less than that associated with truck transport, although railroad facilities are more capital intensive than truck facilities. Truck is the least expensive mode for liquid sludge transport over one-way distances of 20 miles or less and for sludge volumes less than 10-15 million gallons/year. Pipeline is the least expensive transport mode when the annual sludge volume is greater than approximately 30-70 million gallons, depending on distance. Pipeline is not economically attractive for annual sludge volumes of 10 million gallons or less because of the high capital investment. Rail and barge are comparable over the 7-700 million gallon volume range for long haul distances. Barge is more economical than rail for short to medium distances and for annual sludge volumes greater than 30 million gallons.

*Cost comparisons, *Cost analysis, *Sludge, *Transportation, Pipelines, Railroads, Barges, Costs, Economics, Evaluation, Waste disposal

Trucks

J108

THE SYMBIOTIC APPROACH TO WATER REUSE IN ST. PETERSBURG, FLORIDA,

Dove, L. A.

Black, Crow and Eidsness, Incorporated,
Clearwater, Florida.

In: 3rd National Conference on Complete WateReuse, June 27-30, 1976, Cincinnati, Ohio, p 15-22. 3 fig, 3 tab, 16 ref.

Research and development programs employing the symbiotic approach for water reuse in St. Petersburg, Florida are outlined. The programs include: Deep well injection and possible recovery of storm water and treated waste water as a replacement for imported groundwater; zero discharge and total recycling of treated waste water for irrigation, air conditioning, power plant uses, and other applications; the installation of 25,000 water-saving devices in private toilets to reduce potable water usage; the production of dried waste water sludge for sale to commercial fertilizer compounders; and the application of digested sludge as a soil conditioner. A tentative layout for a centralized sludge dewatering and drying facility for the city is also presented.

*Water reuse, *Recycling, *Byproducts, Waste water, Sludge, Fertilizers, Dewatering, Drying, Irrigation, Injection wells, Groundwater, Florida, Cities, Research and development, Potable water, Water utilization, Treatment facilities, Waste treatment

J109
SOLID WASTE, SEWAGE, AND ENERGY - A SYMBIOTIC APPROACH,

Dale, J. C.

Energy Management Group,
New York, New York.

In: 3rd National Conference on Complete WateReuse, June 27-30, 1976, Cincinnati, Ohio, p 35-36.

The potential benefits of using a symbiotic approach to solve problems associated with the generation of municipal and industrial solid wastes and sewage, industrial water supply needs, and fuel shortages are discussed. A hypothetical example involving a city with a population of 100,000 is used to show that waste garbage, sewage, and animal wastes can be used for producing gas fuel for industrial needs and char which can be used as filter media for tertiary treatment at a sewage treatment plant. The treated sewage effluent can then be reused for industrial purposes not requiring potable water.

*Water reuse, *Recycling, *Waste water treatment, *Cities, Water supply, Industrial wastes, Municipal wastes, Sewage, Water utilization, Fuels

J110
THE U. S. ENVIRONMENTAL PROTECTION AGENCY: PAST AND FUTURE CHALLENGES,

Train, R. E.

U.S. Environmental Protection Agency,
Washington, D. C.

In: 3rd National Conference on Complete WateReuse, June 27-30, 1976, Cincinnati, Ohio, p 43-45.

Environmental Protection Agency activities in the areas of waste water treatment and water reuse are reviewed along with future challenges in these areas. Since the establishment of the Agency, it has committed almost $11 billion in grants to states and communities for the construction of waste water treatment plants. The Agency has put strong emphasis on research and development activities associated with water reuse. The reuse of municipal waste water is currently being practiced on a continuing basis in 358 locations throughout the United States, chiefly in the semi-arid southwestern states. Principal applications for waste water reuse include irrigation and landscaping, industrial cooling and processing water utilization, and recreational lake maintenance. The present reuse of waste water, however, is small in relation to the amount of municipal waste water being generated, and expanded practice and continued development of municipal waste water reclamation is required.

*Water reuse, *Recycling, *Symbiosis, *Municipal wastes, *Waste water, Irrigation, Reclamation, Reclaimed water, Recreation facilities, Lakes, Industrial water, Research and development, Government supports, Government finance, Organizations, Treatment facilities

J111
EXAMPLE FOR REGIONAL PLANNING OF WATER QUALITY IN DENMARK
(BEISPIEL EINER REGIONALEN PLANUNG DER GEWAESSERQUALITAET IN DAENEMARK),

Posselt, G.

Forum Umwelt Hygiene, Vol. 27, No. 5, p 160-164, 1976. 1 fig, 2 tab, 6 ref.

A simple scheme for water quality planning in a given region of Denmark uses the classes of the saprobic system. An analysis of the fundamental physical factors for water quality in nearby areas at streams of the region's drainage basins is the plan's basis. This analysis determines the best possible saprobic level after eliminating all known sewage discharges in the area. The next step is a statement of human demands regarding activities at or near watercourses. Dialogue with local associations, municipal organizations, and others interested in sufficient water supplies is necessary. The temporary water quality goal can be defined by comparison of the basic saprobic level, expressing the physical influence of the surroundings, with that level of saprobity which is assumed to assure the various needs of the population. The necessary measures are then drafted. The plan's feasibility is then determined by evaluating the probable costs.

*Planning, *Water quality, *Europe, *Streams, *Watersheds (basins), Sewerage, Human population, Water demand, Evaluation, Costs

*Saprobic levels, Denmark

J112
OPERATION AND IMPACT OF NPDES IN REGION II, PART 2,

Muszynski, W. J., and Olenik, T. J.

United States Environmental Protection Agency,
Caribbean Construction Grants Branch.

Water and Sewage Works, Vol. 123, No. 6, p 93-95, June, 1976. 2 tab, 10 ref.

The National Pollutant Discharge Elimination System is discussed in terms of the permit program's operation and its physical and economic impact on municipal dischargers in the Region II area which includes New York, New Jersey, Puerto Rico, and the Virgin Islands. The monitoring, testing, and reporting requirements of the permit program are generally much more stringent than previous requirements under state programs. Most permits require weekly 24-hour composite sampling of biochemical oxygen demand and suspended solids. Case histories of the economic impacts of the permit program are reviewed for the upgrading of existing facilities, industrial waste monitoring, and the installation of flow, monitoring, and chlorination equipment. A detailed cost analysis is presented for each case reviewed.

*Permits, *Regulation, *Industrial wastes, *Pollutants, *Economics, Monitoring, Effluents, New York, New Jersey, Puerto Rico, Virgin Islands, Programs, Cost analysis, Biochemical oxygen demand, Suspended solids, Waste water treatment, Equipment

National Pollutant Discharge Elimination System

J113
AWT ENERGY NEEDS - A PRIME CONCERN,

Argo, D. G., and Wesner, C. M.

Orange County Water District,
Fountain Valley, California.

Water and Wastes Engineering, Vol. 13, No. 6, p 46-48, June, 1976. 2 tab.

Off-site energy requirements associated with the operation of an advanced waste water treatment plant in Orange County, California are reviewed. Secondary effluent not reclaimed by the plant is discharged into the Pacific Ocean by pumping through an outfall and requires about 3000 kilowatt-hours/day for 15 mgd of effluent. The total maximum energy required to reclaim 15 million gallons/day of waste water is 95,000 kilowatt-hours without demineralization and 130,000 kilowatt-hours/day with demineralization by reverse osmosis. These energy requirements include all treatment units and auxiliaries, such as plant water and lighting; also included are all energy requirements to manufacture and deliver consumable supplies used in the waste water reclamation process. A detailed breakdown of energy requirements is given by unit operation.

*Reclamation, *Waste water treatment, *Energy budget, *Tertiary treatment, *Treatment facilities, *Electric power demand, *Reclamimed water, Water reuse

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J114
STIMULATION OF DENITRIFICATION IN SOIL COLUMNS BY ADDING
ORGANIC CARBON TO WASTEWATER,

Lance, J. C., and Whisler, F. D.

U.S. Department of Agriculture,
Agricultural Research Service,
Phoenix, Arizona,
Water Conservation Laboratory.

Journal Water Pollution Control Federation, Vol. 48, No. 2, p 346-356, February, 1976. 7 fig, 2 tab, 19 ref.

Soil columns were intermittently flooded with waste water adjusted to different soluble carbon concentrations by adding dextrose or methanol to investigate the effect of organic carbon on denitrification. Methanol was not effective in promoting denitrification in soil columns flooded with secondary waste water; however nitrogen removal was increased from 30-90% by increasing the soluble carbon concentration of the waste water to 150 mg/liter via the addition of dextrose. This showed that the organic carbon content of waste water is capable of limiting denitrification in high-rate land filtration systems and that both nitrification and denitrification may be achieved in the same soil profile by alternating flooding and drying periods. Further research is needed to determine if most of the carbon would be removed from primary waste water effluent by high-rate land filtration and to determine if denitrification can be stimulated by adding carbon in a pulse at the beginning of the flooding period.

*Denitrification, *Carbon, *Waste water treatment, *Soil filters, *Recycling, Symbiosis, Nitrification, Nitrogen, Efficiencies, Filtration, Chemical reactions, Organic compounds, Evaluation

Dextrose

J115

AIRBORNE COLIPHAGES FROM WASTEWATER TREATMENT FACILITIES,

Fannin, K. F., Spendlove, J. C., Cochran, K. W., and
Gannon, J. J.

Michigan University,
Ann Arbor,
School of Public Health.

Applied and Environmental Microbiology, Vol. 31, No. 5, p 705-710, May, 1976.
6 tab, 30 ref.

Waste water treatment plant emissions of airborne coliphages that form plaques on two strains of Escherichia coli were investigated. Two activated sludge and two trickling filter plants were investigated using large volume air samplers with recirculation devices. Coliphages were enumerated by a most probable number procedure. Average coliphage levels in the airborne emissions of trickling filter beds and activated sludge units were 0.284 and 0.302/cu m, respectively; sewage liquor concentrations from the above sources were 448,000 and 2.94 million plaque-forming units/liter, respectively, depending on the Escherichia coli host used for the assay. The isolation of low levels of coliphages from the airborne emissions of waste water treatment plants demonstrates that these viruses can survive natural aerosolization and may be recovered with the procedures used.

*Air pollution, *Viruses, *Waste water treatment, *Treatment facilities, Activated sludge, Trickling filters, Coliforms, Aerosols, Bacteria, Microorganisms, Analytical techniques, Pollutant identification

Coliphages

J116

ENVIRONMENTAL CONTROL IN PLANTS AT MINIMUM COST,

Burnham, C. D.

SNC Consultants Limited,

Water and Pollution Control, Vol. 114, No. 6, p 6-8, 9, June, 1976. 4 fig.

Design and operating practices for controlling water pollution from waste treatment operations at a minimum cost are reviewed. The most effective way to eliminate pollution is at the source by means of raw material, process, and/or equipment changes. For example, the use of countercurrent double rinse tanks that require water addition only when the rinse water is too dirty can reduce drainage system requirements in the metal finishing industry. Segregation of drainage systems can be used to avoid the discharge of possible toxic combinations. Site selection is another factor in achieving environmental control at minimum cost; care should be exercised to avoid building a facility on a flood plain. Water reuse is a pollution control technique which also can provide valuable byproducts and an inexpensive source of process water. An example of water reuse in a cresylic acid plant is presented.

*Water pollution control, *Industrial wastes, *Water reuse, *Design criteria, *Byproducts, Operations, Economics, Toxicity, Drainage systems, Equipment, Materials

J117
A BRIEF HISTORY OF SEWAGE TREATMENT - 2
THE ROYAL COMMISSION,

Sidwick, J. M.

Effluent and Water Treatment Journal, Vol. 16, No. 4, p 193-195, 197-199, April, 1976.

An historical review of the establishment and activities of the Royal Commission on Sewage Disposal is presented. The Commission was appointed on May 7, 1898 to investigate methods of treating and disposing of sewage. Activities of the Commission included: the identification of artificial treatment processes, an evaluation of problems associated with the discharge of trade wastes into municipal sewers, studies of the operational characteristics of various sewage treatment methods, the investigation of problems associated with the disposal of distillery wastes and the nuisances caused by seaweed in sewage polluted estuaries, recommendations for standards to which sewage works effluent should conform, and studies on methods for treating industrial wastes not discharged to municipal sewers.

*Organizations, *History, *Sewage treatment, *Industrial wastes, Waste water treatment, Estuaries, Sewers, Standards

J118
ENVIRONMENTAL SURVEY OF TWO INTERIM DUMPSITES —
MIDDLE ATLANTIC BIGHT,

January, 1974. 158 p, 12 fig, 40 tab, 86 ref, 3 append. Lear, D. W., Smith, S. K., and O'Malley, M. L., editors. Technical Report PB-244 623.

An oceanographic cruise was made in the fall of 1973 to an interim municipal sludge dumpsite and an interim industrial acid waste dumpsite which had been studied on a similar cruise the previous spring. These sites are on the continental shelf in the Middle Atlantic Bight. Hydrographic and bathymetric conditions, major circulation patterns, water quality, sediment composition, heavy metals in sediments and biota, bacteriology, phytoplankton and zooplankton communities, vertebrates, and benthic invertebrates were studied. Temperature and salinity profiles indicated the presence of a pycnocline, but differences between surface and bottom waters were relatively small. Neutral buoyance seabed drifters left by the previous cruise indicated net bottom water movement toward the west and southwest toward the Delaware, Maryland, and Virginia beaches. Nutrient concentration in waters near the bottom varied seasonally. Elevated nitrate plus nitrite concentrations occurred in bottom waters at the municipal sludge site. Phytoplankton populations were characteristic of mid-temperate coastal communities during fall and winter. Higher mercury, nickel, and manganese concentrations in zooplankton samples than from the previous cruise suggest that certain metals may accumulate in zooplankton. Geographic distribution patterns indicate deposition of heavy metals in sediments as a result of waste disposal. Iron concentrations in sand dollars were less than during the spring cruise. A mechanism is postulated in which accumulation at the pycnocline makes iron less available to the bottom community.

*Pollutant identification, *Analytical techniques, *Sludge disposal, *Waste dumps, *Oceans, Surveys, Continental shelf, Cruises, Atlantic ocean, Oceanography, Industrial wastes, Acids

Ocean dumping, Oceanographic cruises, Oceanographic surveys

J119
LAND USE AND WATER QUALITY IN NEW YORK RIVERS,

Haith, D. A.

Cornell University,
Ithaca, New York,
Department of Agricultural and Civil Engineering.

Journal of the Environmental Engineering Division-ASCE, Vol. 102, No. EE1, p 1-15, February, 1976. 7 tab, 27 ref, 2 append.

Correlation and regression analyses were applied to 20 river basins in New York State to study a possible relationship between land use and water quality. The water quality constituents emphasized were nitrogen, phosphorus, and suspended solids, all generally considered to be associated with nonpoint sources (NPS). An attempt was made to determine whether relationships between land use and water quality exist, the land uses whose effect on water quality is most significant, the importance of land use in determining water quality, whether there are quantitative relationships between water quality and land use, and whether the relative importance and significant sources of NPS pollutants can be identified from land use-water quality data. Watershed land use had significant impact on river concentrations of nitrogen and suspended solids, but not phosphorus. Forest, cropland agriculture, and transportation land uses had a major impact on nitrogen concentrations. Urban residential area was important in determining river suspended solids concentrations. Land-use parameters explained most of the variation in nitrogen concentrations, but were less successful in explaining suspended solids variation. A quantitative relationship between nitrogen concentrations and land uses was determined. In many cases, however, it is difficult to infer the importance of NPS pollutants from the data. In the future, water quality management planning must include provisions for the control of water pollution associated with land uses and nonpoint sources.

*Pollutant identification, *Analytical techniques, *Land use, *Water quality, *Rivers, New York, Correlation analysis, Regression analysis, River basins

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J120
MOGDEN, WHERE SEWAGE WORKS,

Ireland, C. W.

Gas and Oil Power, Vol. 71, No. 787, p 161-162, Winter, 1975. 2 fig, 1 tab.

Fuel gas for engines is produced from the treatment of sewage at the Thames Water Authority's Mogden works. Heat recovered from the engine cooling systems raises the sludge digestion temperature to about 32 C. The engines drive generators for electric pumps and other equipment and air compressors delivering about 4.8 million cu m/day to the activated sludge process. The engine commissioned in 1967 was developed taking into account the difficulties of burning the very heavily contaminated sludge gas, and incorporated numerous special features. The fuel gas carries large quantities of condensate due to the close proximity of the digester to the power house. Operating experience made it possible to develop the most efficient combination of engine components, which included many standard components. This experience allowed the engine installed in 1974 to be designed with components interchangeable with those of the 1967 engine. The 1974 engine also incorporated various improvements. The gas and air are mixed in the combustion chamber to avoid any possibility of an explosive mixture being formed in the manifold. The 1974 engine ran almost continuously for its first 12 months. Both engines are dual fuel engines; a pilot injection of diesel fuel oil promotes ignition of the gas and air.

*Waste water treatment, *Sewage treatment, *Sludge digestion, *Treatment facilities, *Gases, *Fuels, Equipment

J121
DISINFECTION,

Hoadley, A. W., and Gould, J.

Georgia Institute of Technology,
Atlanta,
School of Civil Engineering.

Journal Water Pollution Control Federation, Vol. 48, No. 6, p 1166-1170, June, 1976.
45 ref.

A literature survey of papers dealing with the disinfection of water is presented. Specific topics discussed include: methods for the measurement of residual chlorine, the formation of chlorinated organic compounds in chlorinated drinking water and waste water, the effect of chlorine on the enzymes of Escherichia coli, the combined effect of ozone and sonication on the inactivation of pathogenic and non-pathogenic bacteria in secondary waste water effluent, reduction in bacterial count during thermophilic aerobic digestion, the effectiveness of glutaraldehyde for virus deactivation, the use of ultraviolet light for virus deactivation, and procedures for testing and comparing different disinfectants.

*Disinfection, *Potable water, *Waste water treatment, *Water purification, Chlorination, Ozone, Ultraviolet radiation, Bacteria, Viruses, Organic compounds, Chlorine, Coliforms, Enzymes, Analytical techniques, Aerobic treatment

J122
DETERGENTS,

Banerji, S. K.

Journal Water Pollution Control Federation, Vol. 48, No. 6, p 1110-1115, June, 1976.
27 ref.

A literature review of the effects of detergents on waste water treatment processes and the aquatic environment is presented. Topics covered include: the effects of a ban on detergent phosphates on stream nutrient levels, the effects of detergent phosphorus on the growth of different species of algae, the effects of surfactants on fish, the accumulation and elimination of detergent whitening agents in bluegill, the degradation of anionic surfactants in artificial waste water media, the effects of cationic detergents on microorganisms in biological treatment plants, and the effects of carbonate detergents on biological waste treatment.

*Detergents, *Surfactants, *Water pollution effects, *Waste water treatment, *Aquatic environment, Algae, Fish, Anions, Cations, Biological treatment, Phosphates, Carbonates, Nutrients, Phosphorus

Whitening agents

J123
ADMINISTRATION - SYSTEMS ANALYSIS,

Loucks, D. D., and Bell, J. M.

Journal Water Pollution Control Federation, Vol. 48, No. 6, p 1639-1648, June, 1976.
72 ref.

A literature review of the administration of water quality planning and analysis is presented. General topics covered include: comprehensive planning and reviews, land use effects and management, sewer design, waste water treatment systems, waste water disposal on land, waste water reuse, water quality modeling, thermal pollution, monitoring and sampling, and data management. Specific subjects discussed under the above general headings include: methodology for integrating water quantity and water quality management, a method for forecasting the pollution resulting from urban growth, control strategy for minimizing water pollution in receiving water caused by overflows in combined sewer systems, a dynamic programming model for planning the future expansion and operation of a waste water treatment plant, the development of a soil loss, land-water allocation optimization model, simulation studies of the reuse of municipal waste water for water supply augmentation, modeling studies of the effects of variable waste generation and streamflows on water quality, evaluations of deep reservoir models for temperature prediction in lakes, system behavior and cost models for effluent sampling programs, and methods for generating information needed for the design of cost effective water quality control programs.

*Water management (applied), *Planning, *Administration, *Water quality, Land use, Waste water treatment, Waste water disposal, Model studies, Sewers, Simulation analysis, Treatment facilities, Water reuse, Optimization, Economics, Monitoring, Sampling, Data collections

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J124
FATE OF METALS IN WASTEWATER DISCHARGE TO OCEAN,

Rohatgi, N. K., and Chen, K. Y.

CDM, Incorporated,
Pasadena, California.

Journal of the Environmental Engineering Division-ASCE, Vol. 102, No. EE3, p 675-685, June, 1976. 6 fig, 4 tab, 9 ref, 1 append.

Experimental results on the settling velocity of sludge solids were used to determine the annual deposition of trace metals on the Santa Monica Bay floor. Trace metal concentrations around the outfall areas are generally lower than the corresponding metal concentrations in the waste effluent particulates. Calculations indicate that approximately 30% of the total solids discharged will be deposited in the sediment and the remainder transported at 0.1 m/sec. About 10% of the total of cadmium, copper, nickel, lead, and zinc will be deposited within 2 km of the outfall. Predictions using experimental data indicate that a significant amount of soluble trace metals will be made available to marine organisms from the discharge of waste water effluent. Their validity can be argued because of the size and complexity of the ocean system. It is certain, however, that only a small portion of trace metals from waste water suspended particulates is represented by the Santa Monica Bay sediment, the remainder being mobilized into the ocean as soluble trace metals.

*Pollutant identification, *Waste water (pollution), *Discharge (water), *Oceans, *Deposition (sediments), Cadmium, Copper, Nickel, Lead, Zinc

J125

TIOGA RIVER MINE DRAINAGE ABATEMENT PROJECT,

Miorin, A. F., Klingensmith, R. S., and Heizer, R. E.

Commonwealth of Pennsylvania,
Harrisburg, Pennsylvania,
Department of Environmental Resources.

June, 1976. 71 p, 18 fig, 15 tab, 3 ref. Technical Report EPA-600/2-76-106.

A mine drainage abatement demonstration project for a mined area in the vicinity of Morris Run Village in Tioga County, Pennsylvania was determined to be feasible. The primary objective of the project is to demonstrate the effectiveness of various preventive measures in eliminating or reducing acid mine drainage discharges. The recommended project includes demonstrating effective techniques for mine drainage abatement, reducing a specific mine drainage problem, and restoring portions of a mined area to their approximate original surface grade. The project calls for the restoration of two strip mines; agricultural limestone will be used to establish vegetation in one and sewage sludge to establish vegetation in the other. The mine to be restored using sewage sludge covers 60 acres. Spoil piles will be used for fill. The site will be restored to its original grade, and holding or infiltration ditches will be constructed immediately downhill from the test plot. Three inches of sewage sludge will be placed on a 4.3-acre test plot and scarified into the top cover. The appropriate amount of grass seed will then be placed on the test plot. It is estimated that implementation of the project will result in a reduction of 8,480 lbs per day of acid under average groundwater conditions. Significant reductions in high flows and loadings are expected from mine drainage discharges during and immediately after precipitation. It is estimated that preventing the runoff from a one-inch 24-hour rainfall from entering the interconnected deep mines will result in a reduction of 63,200 lbs of acid. These reductions should cause an improvement in river water quality.

*Watersheds (basins), *Drainage, *Mining, *Coal mines, *Strip mines, *Mine drainage, Mine acids, Pollution abatement, Pennsylvania, Land reclamation

Tioga County Pennsylvania, Surface mine reclamation

J126

FREEZE TREATMENT OF ALUM SLUDGE,

Wilhelm, J. H., and Silverblatt, C. E.

Envirotech Corporation,
Salt Lake City, Utah,
EIMCO BSP Division.

American Water Works Association Journal, Vol. 68, No. 6, p 312-314, June, 1976.
5 fig, 1 tab, 1 ref.

Improving sludge characteristics by freeze treatment and application of the method to difficult sludge situations were studied. The sludge particles are dehydrated when the water closely associated with them freezes. After thawing, the particles retain the new sizes and shapes produced by dehydration, and the consequent rapid dewatering properties. The sludge must be frozen completely for a sufficient length of time to dehydrate the particles. Freeze treatment is sometimes followed by thickening and drying steps, but the drainage properties of the treated solids are so good that the treated slurry could be sent directly to a lagoon or drying bed. Natural freezing could be used in cold climates in winter if the sludge is completely frozen and the treated solids can be conveniently harvested after thawing. The refrigeration equipment for freeze treatment is relatively maintenance-free and operates continuously without operator attention. The electric power to operate such a unit often costs the same or less than the pre-treatment chemicals that would be required for other treatment methods. Freeze treatment is effective for any sludge quality. Because no chemical conditioners or additives are used, they cannot leach into ground water when the sludge is used as land fill. The freeze-treated sludge alone can support vegetation. Because this sludge retains its good dewatering and drainage properties indefinitely, it will not become gelatinous and cause drainage problems in a land-fill operation.

*Sludge treatment, *Freezing, *Sludge, *Dehydration, *Dewatering, Treatment facilities, Drainage, Refrigeration, Operating costs, Landfills

J127

CHEMICAL AND PLANT EXTRACTABILITY OF METALS AND PLANT GROWTH ON SOILS AMENDED WITH SLUDGE,

Gaynor, J. D., and Halstead, R. L.

Agriculture Canada,
Ottawa, Canada,
Soil Research Institute.

Canadian Journal of Soil Science, Vol. 56, No. 1, p 1-8, February, 1976. 3 tab, 28 ref.

Sludge was mixed with three soils with widely different properties and incubated, then the mixture was seeded with lettuce and tomato. The soils used were Fox sandy loam (sl), Granby sl, and Rideau clay (c). Sludge addition increased soil pH, total carbon, sodium-bicarbonate extractable phosphorus, cation exchange capacity, and exchangeable calcium. DTPA-extractable cadmium increased 2 to 5 times, lead 2 to 3 times, copper 3 to 7 times, and zinc 7 to 31 times. Incubation for 11 months did not greatly change metal extractability in Granby and Fox sl soils, but extractable zinc, copper, lead, and cadmium were reduced in the clay soil following incubation. Raising lettuce reduced the quantity of metal extracted from Fox sl soil and, to a lesser extent, from Rideau c soil, but not from Granby sl soil. Lettuce yields were significantly reduced for the first crop grown on Rideau c and Granby sl soils mixed with fertilizer and sludge compared to yields produced by these soils treated with fertilizer only. All three harvests were reduced with sludge-treated Fox sl soil. The yield reductions for the first two soils were attributed to a salt effect. Raising crops decreased the saturation extract conductivities for all sludge treated soils. Generally, zinc, copper, and lead tissue concentrations in lettuce from Fox and Granby sl soils were significantly increased but total uptake was only increased for zinc. Metal uptake and tissue concentrations for lettuce grown on Rideau c soil treated with sludge and fertilizer were equal to or less than in lettuce from Rideau c soil treated with fertilizer only. Similar trends were observed to a lesser extent with tomatoes.

*Pollutant identification, *Plant growth, *Loam, *Clays, *Sludge, Cadmium, Lead, Copper, Zinc

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J128

SANITARY LANDFILL LEACHATES AND THEIR TREATMENT,

Chian, E. S. K., and DeWalle, F. B.

Illinois University,
Urbana,
Department of Civil Engineering.

Journal of the Environmental Engineering Division-ASCE, Vol. 102, No. EE2, p 411-431, April, 1976. 5 fig, 6 tab, 52 ref, 1 append.

Leachate samples were collected from landfills in different parts of the United States and analyzed for both organics and inorganics. Ratios such as COD/TOC, BOD/COD, VS/FS, and total carbon present in the free volatile fatty acids/TOC were determined for the leachate. These ratios can be used to predict the effectiveness of either biological or physico-chemical treatment methods with a given leachate. Some are also used as an internal check on the reliability of the results of chemical analysis of leachate samples. Leachate from recently leaching landfills is best treated by biological treatment, which is most effective in removing the free volatile fatty acids which are present in large quantities. Physical-chemical treatment is most effective for treating leachate from stabilized landfills or further removing organic matter in the effluent of biological units treating leachate. Activated carbon and reverse osmosis were best among the physico-chemical processes evaluated for removing organic matter.

*Waste water treatment, *Pollutant identification, *Biological treatment, *Analytical techniques, Biochemical oxygen demand, Chemical oxygen demand, Landfills, Leachate

Physico-chemical treatment

J129

CALCIUM HYDROXIDE (LIME) AND THE ELIMINATION OF HUMAN PATHOGENIC VIRUSES FROM SEWAGE: STUDIES WITH EXPERIMENTALLY CONTAMINATED (POLIOVIRUS TYPE 1, SABIN) AND PILOT PLANT SAMPLES,

Sattar, S. A., Ramia, S., and Westwood, J. C. N.

University of Ottawa,
Ottawa, Canada,
Faculty of Medicine.

Canadian Journal of Public Health, Vol. 67, No. 3, p 221-226, May-June, 1976.
4 tab, 12 ref.

Use of lime was studied as a means to eliminate viruses from sewage. Sewage samples were contaminated with poliovirus 1. An aqueous slurry of lime was then added drop by drop until the pH reached 11.5. After 15 more min of stirring, the sample was allowed to stand for one hr. No virus was detected in rhe resulting supernatant; the virus recovered from the sludge represented only 0.001% of the virus added. This remaining virus was undetectable after storing the sludge for 24 hr at 28 C. Lowering the temperature of the samples to 4 C did not affect the process efficiency in eliminating viruses.

*Waste water treatment, *Sewage treatment, *Sewerage, *Pollutant identification, *Lime, *Viruses, Sewage sludge, Waste storage, Temperature, Public health

Chemical treatment

J130

LATEST U.S. SEWAGE REGULATIONS,

Roberts, W. F.

Marine Engineering/Log, Vol. 81, No. 6, p 34-37, June, 1976. 2 fig.

Legal terms relating to shipboard sewage treatment are defined. Only sewage and other waste water coming into contact with it are required to be treated. The three basic negative effects of dumping raw sewage from vessels are the visual insult of raw sewage, the health hazard from pathogenic organisms and the pollution problems, such as oxygen depletion of the water. The harmful effects of vessels on the open seas are marginal, but serious problems can be caused in estuaries, bays, rivers, and lakes. Flow-through sewage treatment is now allowed for all oceangoing vessels. Tests and certification are required for these systems. Possible marine sanitation devices (MSD's) to meet the regulations include a holding tank, vacuum or pressure flushing, total incineration, maceration/chlorination, biological flow-through treatment, physical-chemical flow-through treatment, recycling, and individual unitized toilets. Operational considerations include as much automatic operation as possible, a minimum of sewage treatment skills required, minimum use of expendables, reliability, ease of maintenance, minimizing personnel objections, and elimination of need for shore accomodations. Different systems are more appropriate in different situations. A compilation of manufacturer's information on MSD's is included.

*Waste water treatment, *Sewage treatment, *Biological treatment, *Sewerage, *Treatment facilities, Regulation, Ships, Regulations

J131
ODOR CONTROL WITH HYDROGEN PEROXIDE,

Cole, C. A., Paul, P. E., and Brewer, H. P.

Pennsylvania State University,
Middletown,
Engineering Department.

Journal Water Pollution Control Federation, Vol. 48, No. 2, p 297-306, February, 1976.
5 fig, 3 tab, 5 ref.

Hydrogen peroxide treatment was investigated as a method of controlling the odors emanating from the Hershey waste water plant, which treats approximately 2 mgd of domestic and industrial waste. The plant odors came predominantly from the flotator-clarifier effluent that was aerated in the preaeration tank and exposed to air in the plastic media trickling filter and from the intermediate clarifier effluent that was exposed to air in the intermediate rock trickling filter. Hydrogen sulfide produced under anaerobic conditions in the flotator-clarifier and intermediate clarifier apparently produced the odor. Two winter tests followed by continuous use starting in the early summer demonstrated the effectiveness of hydrogen sulfide for controlling the odor. A dose of between 15 and 40 mg/liter hydrogen peroxide divided between the effluent from the plastic media trickling filter and the feed to the flotator-clarifier was effective. On-site observations and off-site tests by an odor panel verified the odor reduction. Adding 10 mg/liter hydrogen peroxide to the feed of the flotator-clarifier and intermediate clarifier during the afternoon high flow time increased the dissolved oxygen (DO) in the effluent of each by one to 2 mg/liter. Adding 10 mg/liter hydrogen peroxide did not improve the early morning low flow DO.

*Waste water treatment, *Pollutant identification, *Treatment facilities, *Odor, *Control, Domestic wastes, Industrial wastes, Effluents, Hydrogen sulfide

*Odor control, Hydrogen peroxide, Clarifiers

J132
SOLID WASTES AND WATER QUALITY,

Heidman, J. A., and Brunner, D. R.

Environmental Protection Agency,
Washington, D. C.,
Wastewater Research Division.

Journal Water Pollution Control Federation, Vol. 48, No. 6, p 1299-1305, June, 1976.
40 ref.

A review of literature dealing with the effect of solid waste disposal on water quality is presented. Topics covered include: factors affecting leachate formation and control, a numerical procedure for evaluating the environmental impact associated with land disposal, the use of earth resistivity surveys to define groundwater contamination, techniques for monitoring landfill sites, the chemical characteristics of two leachate plumes near oil landfills, the groundwater quality underlying landfills in Alaska, the design of a demonstration landfill in an area with very high groundwater, analytical procedures for leachate composition studies, an evaluation of the combined disposal of waste water sludges and municipal refuse in a sanitary landfill, leachate management alternatives, materials used for containing leachates at sanitary landfill sites, the design of an experimental papermill sludge landfill, and the design and operation of an on-site leachate collection, treatment, and disposal facility at a landfill site.

*Solid wastes, *Waste disposal, *Water quality, *Landfills, *Leachate, Groundwater, Water pollution, Sludge, Municipal wastes, Industrial wastes, Waste treatment, Design criteria, Monitoring, Analytical techniques, Materials

J133
WASTES FIND FERTILE FIELD AS LOW-COST PLANT NUTRIENTS,

Kohn, P. M.

Chemical Engineering, Vol. 83, No. 16, p 43-45, August 2, 1976. 1 fig.

Developments in the use of transformed liquid waste as fertilizer are reviewed along with problems hindering the increased recycling of such wastes. The city of Houston, Texas, is presently flash-drying its activated sludge to form a material called 'Hou-Actinite.' The product has a nitrogen-phosphorus-potassium analysis of 5-5-0 and is sold to Texas rice farmers, Florida citrus growers and others. Hou-Actinite sells at $25-31/ton. Although this price brings no profit, the conversion of sludge to Hou-Actinite is preferable to using landfill as a disposal means. Pacific Disposal Systems, Incorporated, a firm that handles hazardous chemical wastes, plans to go onstream in the near future with a system that will convert waste nitric acid to ammonium nitrate which will be marketed as a fertilizer. Major drawbacks to the widespread use of wastes as fertilizers include their low nitrogen-phosphorus-potassium nutrient value, their high bulk and water content, and their variable quality. Also, the low value of such fertilizers makes their storage expense relatively high.

*Waste treatment, *Sludge treatment, *Fertilizers, *Recycling, *Symbiosis, Municipal wastes, Industrial wastes, Sludge treatment, Economics, Nitrogen, Phosphorus, Potassium, Chemical wastes

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J134
DECREASE OF BACTERIAL CONTENT IN DIFFERENT TYPES OF STABILIZATION PONDS,

Parhad, N. M., and Rao, N. U.

Indian Journal of Environmental Health, Vol. 18, No. 1, p 33-46, 1976. 8 fig, 2 tab, 11 ref.

Stabilization ponds at three different locations in Nagpur, India were studied to determine decreases in bacterial content. Samples were collected and analyzed for standard plate count, coliforms, E. coli, Enterococci, and biochemical oxygen demand. The pond showing the highest percentage reductions in both biochemical oxygen demand and indicator bacteria had a greater length of liquid travel and a higher initial organic concentration than the other two ponds. Its interconnecting arrangement which permitted surface overflow from one cell to the next, facilitating the transfer of a much larger algal population to the subsequent cell, also appeared responsible for its greater efficiency. The results of the study indicate that in addition to loading, detention period, and other design criteria such factors as the interconnecting arrangement between cells, the mode of operation, and the length of liquid travel also contribute to the bacterial removal efficiency of stabilization ponds.

*Biological treatment, *Stabilization, *Ponds, *Bacteria, Coliforms, E. coli, Biochemical oxygen demand, Performance, Efficiencies, Waste water treatment, Design criteria

Enterococci

J135

DISCOUNTED CASH FLOW ANALYSIS TO SELECT EQUIPMENT,

Briller, R.

Entech Corporation,
Dumont, New Jersey.

Journal of the Environmental Engineering Division-ASCE, Vol. 102, No. EE3, p 595-611, June, 1976. 6 tab, 2 ref.

A discounted cash flow analysis method for selecting waste water treatment equipment with the lowest overall cost is presented. Operating and capital costs as well as equipment life and discount rate are used as input for a specific example involving surface aerators in a municipal sewage treatment plant. Realistic values in terms of capital and operating costs, inflation rate, and other variables are also used in the example. The results show that an aerator which costs $5000 more but uses 4-5 horsepower less and one-fifth as much lubricating oil is $5723 cheaper than another aerator in terms of the present value of the total overall costs. The most sensitive variable in the example is the efficiency of the aerators. An improvement of 4.2% in the efficiency of the cheaper aerator is sufficient to eliminate the overall cost differential. A general examination of the sensitivity analysis used for the above example reveals that variables which are less critical in the example problem can become more significant for cases where different values of the independent variables are used.

*Cost analysis, *Waste water treatment, *Aeration, *Efficiencies, *Cost comparisons, Economics, Equipment, Operating costs, Capital costs

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J136

CHARACTERISTICS OF RURAL HOUSEHOLD WASTEWATER,

Siegrist, R., Witt, M., and Boyle, W. C.

Wisconsin University,
Madison,
Small Scale Waste Management Project.

Journal of the Environmental Engineering Division-ASCE, Vol. 102, No. EE3, p 533-548, June, 1976. 3 fig, 17 tab, 15 ref.

Water use was monitored at 11 rural homes for about a month and waste water quality was monitored at three of the residences. Water usage yielded an average flow of 42.6 gallons/capita/day. Laundry, bath/shower, toilet flushings, dishwashing, water softener use, and other events accounted for the following percentages of water use: 24.7%, 23.5%, 21.5%, 11.4%, 6.2%, and 12.7%, respectively. The average daily contributions of biochemical oxygen demand, suspended solids, total nitrogen, and total phosphorus were 0.109, 0.77, 0.013, and 0.009 pounds of pollutant/capita/day, respectively. Bacteriological analyses indicated wide variation in indicator organisms and the possibility of pathogenic organisms in bath and laundry waste waters. Therefore, disinfection of these prior to reuse is recommended.

*Domestic water, *Domestic wastes, *On-site investigations, *Water requirements, Biochemical oxygen demand, Suspended solids, Nitrogen compounds, Phosphorus compounds, Microorganisms, Disinfection, Water reuse

J137
CAUSES AND ALTERNATIVE SOLUTIONS TO THE WATER QUALITY PROBLEMS OF
BIG STONE LAKE, WESTERN MINNESOTA-NORTHEASTERN SOUTH DAKOTA,

Hylton, A. R., Flippin, R., Aleti, A., Ward, J. R., and
Rasmussen, J.

Journal of Environmental Sciences, p 27-32, May/June, 1976. 5 fig, 1 tab, 11 ref.

Eutrophication problems associated with Big Stone Lake, a natural lake which lies in the valley of a former glacial river at the western Minnesota-northeastern South Dakota border, are discussed along with some alternatives for eliminating the problem. There are three general types of algae common to the lake: filamentous algae, free floating planktonic algae, and planktonic blue-green algae. The most obvious water quality changes which have occurred in the lake in recent years are an enrichment in phosphates and nitrates and increased siltation and turbidity. The adverse effects of man's influence on the lake's environment may be partially corrected by the following measures: reducing nutrient inflow from feedlots, selective dredging, periodic removal of rough fish, the use of upstream reservoirs, and acceptable land treatment measures. An analysis of the comparative economics of the above control measures is also presented.

*Water pollution effects, *Eutrophication, *Lakes, *Algae, *Control, Minnesota, South Dakota, Phosphates, Nitrates, Turbidity, Silts, Nutrients, Fish, Reservoirs, Economics, Dredging

J138
WASTEWATER SLUDGE AS A FERTILIZER SUBSTITUTE,

Forster, D. L., Logan, T. J., Miller, R. H., and
White, R. K.

Ohio State University,
Columbus,
Agricultural Economics.

Public Works, Vol. 107, No. 8, p 79-80, August, 1976. 2 tab, 3 ref.

Data from a survey of waste water sludge land spreading practices in 43 communities throughout the state of Ohio are presented. The survey showed that all but nine of the communities using sludge as fertilizer were employing some type of sludge analysis at least semi-annually. About a third of the communities were also checking water quality near disposal sites. The equipment used for applying the sludge to land consisted mostly of tank trucks with either gravity or pumped discharge. Only four of the communities employed irrigation-overland flow systems. Average sludge handling costs per dry ton ranged from $25.20 for a plant flow capacity of 20 million gallons/day to $69.70 for a flow of 2 million gallons/day. Negative attitudes among landowners were associated mostly with concern about the possible existence of heavy metals, the possible survival of pathogenic viruses and human parasites, and the effect of runoff on water quality.

*Sewage sludge, *Fertilizers, *Sludge disposal, *Farms, Costs, Irrigation, Overland flow, Ohio, Surveys, Viruses, Heavy metals, Monitoring, Attitudes

Land spreading

J139
BIOASSAY PROCEDURES FOR THE OCEAN DISPOSAL PERMIT PROGRAM,

May, 1976. 106 p, 9 fig, 12 tab, 87 ref. Technical Report EPA-600/9-76-010.

Bioassay procedures are given which were developed to provide tests for conducting toxicity evaluations of waste materials considered for ocean disposal under the Environmental Protection Agency's (EPA) Ocean Disposal Permit Program. Three of the nine bioassay procedures described, the oyster shell growth procedure, the chronic fish egg-to-egg procedure, and the acetylcholinesterase inhibition test, are not recommended for routine use. At least three species from different taxonomic groups and representing several trophic levels should be used in evaluating a dumping permit. The procedures include both flow-through and static tests. The methods vary in their utility and complexity of performance. The procedures are not intended to be 'standard methods' but as guides for those involved in evaluating ocean dumping permits.

*Pollutant identification, *Analytical techniques, *Bioassay, *Oysters, *Algae, Marine fish, Crustaceans, Brine shrimp, Waste disposal

Ocean Disposal Permit Program

J140
BEFORE REMOVING NUTRIENTS...RE-ANALYZE LAKE TAHOE,

Porcella, D. B., and McGauhey, P. H.

Utah State University,
Logan, Utah,
Water Research Laboratory.

Water and Wastes Engineering, Vol. 13, No. 2, p 17-19, 23, 44, February, 1976.
1 fig, 2 tab.

The use of tertiary effluent as irrigation water for the Indian Creek Reservoir is discussed in relation to the effect of nutrient addition on algal blooms. Observations made at the reservoir after its filling revealed a water quality which is conducive to aquatic weed development but not to phytoplankton blooms. Influent nutrient levels indicated that substantial plant productivity should be observed, and the aquatic weed growth confirmed this to be the case. Factors which may have a role in controlling the presence and quantity of blue green algae in Indian Creek Reservoir include: the presence of excess inorganic nitrogen relative to low phosphorus concentrations, low levels of trace elements which may be limiting to blue greens and other algal groups, the low phosphorus levels in reservoir waters, low concentrations of biostimulatory organic compounds which are probably removed by activated carbon treatment, and the possible toxicity of high nitrogen levels to specific algae.

*Reclaimed water, *Algae, *Nutrients, *Reservoirs, *Plant growth, Reclamation, Phosphorus, Nitrogen, Phytoplankton, Phytotoxicity, Organic compounds, Irrigation

J141

REMOVAL VS BENEFITS: IT CAN BE TOO COSTLY,

Boyd, D. R., Jr., Popalisky, J. R., Reece, J. D., and
McMurtrey, D.

Kansas City Water and Pollution Control Departments,
Kansas City, Missouri.

Water and Wastes Engineering, Vol. 13, No. 2, p 42-44, February, 1976. 4 fig.

Complete nutrient removal at sewage treatment facilities discharging to the Missouri River is discussed in terms of the resulting benefits versus the costs. The volume of sewage at Kansas City is less than 1% of the minimum Missouri River flow in the area, and this fact combined with detection and removal of nutrients at the Kansas City water treatment facility where the volume of water requiring treatment for nutrient removal is also less than 1.0% of the river flow is cited as reason for not removing nutrients at sewage treatment facilities. The quality of water currently in the Missouri River is such that advanced waste treatment for Kansas City would probably have an insignificant effect on the quality of the water in the receiving stream.

*Sewage treatment, *Nutrients, *Waste water treatment, *Water purification, *Water quality control, Missouri river, Missouri, Cities, Municipal wastes, Economics, Treatment facilities

J142

WATER RECLAMATION: TECHNOLOGY AND PUBLIC ACCEPTANCE,

Stone, R.

Ralph Stone and Company, Incorporated,
Engineers,
Los Angeles, California.

Journal of the Environmental Engineering Division-ASCE, p 581-594, June, 1976.
7 fig, 4 tab, 3 ref.

Public attitude surveys among 10 Southern California communities, industrial plant management, public water resources officials, and water resources management experts were conducted to assess the public acceptance and technological feasibility of water reclamation. Public attitudes were largely accepting the lower contact uses. The public reuse of waste water for higher contact uses, particularly human consumption, encountered more severe constraints in attitude due to the higher treatment costs associated with additional treatment and possible adverse effects on public health resulting from the danger of treatment plant failure. Reuse in industrial cooling and processing appears particularly promising due to its low contact nature and relatively large water use. Reuse of waste water for other nonbody contact purposes, particularly agriculture (irrigation), also appears promising. Existing technology is generally sufficient to provide waste water of acceptable quality for all uses; however, improvements in the detection and removal of viruses are needed.

*Attitudes, *Reclamation, *Water reuse, *Surveys, *Feasibility, Public health, Viruses, Industrial water, Irrigation, Reclaimed water, Waste water treatment, Costs

J143

AN OVERVIEW: SO YOU WANT TO RECYCLE YOUR WASTEWATER? HOW SHOULD YOU BEGIN? IS IT FEASIBLE,

Mace, G. R.

Industrial Water Engineering, Vol. 14, No. 2, p 24-26, April/May, 1976. 5 tab.

A systematic approach for analyzing the economics of waste water disposal versus reuse is presented. The approach consists of four major steps: a detailed analysis of the effluent, a determination of the effect of recycle water on product quality, a survey of waste treatment operations available, and a total economic analysis. Cost data for a hypothetical problem involving the following three alternatives are presented: purchase and sewer disposal of 100% of the water, recycle of 50% and sewer disposal of 50% of the waste water, and recycle of 90% and river discharge of 10% of the waste water. The figures cited are intended only to demonstrate the results that can be derived from a well planned program of industrial plant design.

*Water reuse, *Waste water treatment, *Reclamation, *Industrial water, Cost-benefit analysis, Reclaimed water, Economics, Design criteria, Waste disposal

J144

CHEMICAL CHANGES IN THE SOIL SOLUTION FROM A SPODOSOL IRRIGATED WITH SECONDARY-TREATED SEWAGE EFFLUENT,

Hortenstine, C. C.

Florida Agricultural Experiment Station,
Gainesville,
Soil Science Department.

Journal of Environmental Quality, Vol. 5, No. 3, p 325-338, July-September, 1976.
6 fig, 1 tab, 10 ref.

Chemical changes in spodosols from near Orlando, Florida were investigated after irrigation with secondary-treated sewage effluent. Irrigation at a rate of 5 cm/week was initiated in July 1972 in an attempt to determine the renovative capability of the Spodosols. Phosphorus content increased from 0.03 ppm at all soil depths in the fall/winter of 1971/1972 to 1.25 ppm at 60 cm, 1.00 ppm at 90 cm, and 0.85 ppm at 120 cm by the fall of 1974. During this same period, potassium increased from 0.05 ppm at all three depths to 14 ppm. Nitrate-nitrogen, however, was consistently below 1.0 ppm. The effluent contained an average of 2.2 ppm nitrate-nitrogen, 14 ppm Kjeldahl nitrogen, 2.8 ppm phosphorus, and 16 ppm potassium. Laboratory tests of the soil indicated satisfactory nitrification; however, adverse conditions in the field curtailed the nitrifying process. Proper water control by tile installations will likely provide conditions that are suitable for nitrification.

*Irrigation effects, *Waste water disposal, *Soil analysis, *Chemical analysis, Nitrogen, Phosphorus, Potassium, Nitrates, Nitrification, On-site investigations

Spodosols

J145
URBAN SLUDGE DISPOSAL OR UTILIZATION ALTERNATIVES
SOCIO-ECONOMIC FACTORS,

Montague, A.

Environmental Protection Agency,
Philadelphia, Pennsylvania,
Region III.

In: Proceedings of the 1975 National Conference on Municipal Sludge Management and Disposal, August 18-20, 1975, Anaheim, California, p 60-64. 4 tab.

Socio-economic factors affecting the implementation of various urban sludge disposal and utilization alternatives are discussed, with particular emphasis on land spreading. Although resistance in rural areas by neighboring communities to accept land spreading as a means of sludge utilization has been minimal, the same climate of receptiveness and cooperation has not yet developed in many large metropolitan areas. One source of concern hindering the use of municipal sludge for land spreading purposes is the heavy metal content of sludges. However, once psychological attitudes toward the utilization of waste materials become more favorable, the implementation of prudent management practices in sludge utilization should control the degree of environmental stress. The development of an active public awareness program on the benefits and liabilities of proposed sludge processing systems is recommended along with a realistic program for controlling heavy metals in waste water collection systems. Comparative costs of various sludge disposal and utilization techniques are presented to illustrate the economic advantages of landspreading sludge in specific situations.

*Sludge disposal, *Social aspects, *Economics, *Municipal wastes, *Reclamation, Sludge treatment, Waste water treatment, Attitudes, Symbiosis

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J146
ALTERNATIVES FOR DISPOSAL FOR THE METROPOLITAN DENVER
SEWAGE DISPOSAL DISTRICT NO. 1,

Martin, W. J., and Boyle, J. D.

Metropolitan Denver Sewage Disposal
District Number 1,
Commerce City, Colorado.

In: Proceedings of the 1975 National Conference on Municipal Sludge Management and Disposal, August 18-20, 1975, Anaheim, California, p 86-90.

Findings from a study of alternative methods for disposing of or utilizing sludge generated by waste water treatment facilities in the Metropolitan Denver area are presented. Agricultural reuse is considered the most desirable sludge management system for the district based on environmental, engineering, and economic considerations. The system requires little power compared to other alternatives, and methane gas which is a byproduct of anaerobic digestion can be used to heat and mix the digesters. Outside fuel or power will be required only to operate various pumps in the system and vehicles at the drying and distribution center. The reuse system is also attractive because of its relatively simple operation and inherent flexibility for final sludge use. Additionally, the fertilizer or soil conditioner produced from the sludge is a valuable agricultural resource in view of current and projected fertilizer shortages. Research efforts being conducted by the Metropolitan Denver Sewage Disposal District on the environmental impact of sludge utilization are also outlined.

*Sludge disposal, *Municipal wastes, *Reclamation, *Feasibility studies, *Economics, Cities, Colorado, Recycling, Symbiosis, Fertilizers, Waste water treatment, Byproducts

Denver

J147

A SLUDGE POLICY FOR THE 70'S,

Freeman, L. R.

Environmental Protection Agency,
San Francisco, California,
Region IX.

In: Proceedings of the 1975 National Conference on Municipal Sludge Management and Disposal, August 18-20, 1975, Anaheim, California, p 153-155.

Municipal sludge disposal is discussed in terms of the responsibilities of the Environmental Protection Agency for setting a policy consistent with recent environmental legislation. Since Federal law and Federal/state policies require that feasible alternatives to ocean disposal must be pursued, the first step in formulating a sludge disposal technique should involve the reclamation or recycling of it in light of current conservation needs. Emphasis is placed on implementing existing technology to deal with existing or impending sludge disposal problems. The importance of effective institutional arrangements and public participation in the implementation of sludge disposal policies is discussed.

*Sludge disposal, *Municipal wastes, *Legal aspects, *Institutions, Programs, Waste disposal, Conservation, Recycling, Reclamation

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J148

ECOLOGICAL IMPACT OF THE DISPOSAL OF MUNICIPAL SLUDGE ONTO LAND,

Schmid, J., Pennington, D., and McCormick, J.

Jack McCormick and Associates, Incorporated,
Devon, Pennsylvania.

In: Proceedings of the 1975 National Conference on Municipal Sludge Management and Disposal, August 18-20, 1975, Anaheim, California, p 156-168. 9 fig, 2 tab, 16 ref.

An evaluation of the ecological impact of disposing of municipal sludge on land is presented against the background of current water pollution legislation. A review of major land uses and characteristics in the United States and the potential impact of land disposal on natural vegetation and wildlife indicates that sludge disposal on land can be environmentally acceptable. Sludge application, as contrasted to landfilling, is most appropriate. The most attractive sites for sludge disposal appear to be those that are presently utilized for crop and livestock production. The multiple use of these lands should be considered a national priority so that waste water can be reused to improve soil conditions and fertility. Approximately 18% of the total land surface in the conterminous states is considered to be unsuitable for land disposal.

*Sludge disposal, *Municipal wastes, *Ecology, *Land use, Agriculture, Waste disposal, Legislation, Reclamation, Recycling, Symbiosis

J149

PLANT UPTAKE OF HEAVY METALS FROM SEWAGE SLUDGE APPLIED TO LAND,

Chaney, R. L., White, M. C., and
Simon, P. W.

Department of Agriculture,
Beltsville, Maryland.

In: Proceedings of the 1975 National Conference on Municipal Sludge Management and Disposal, August 18-20, 1975, Anaheim, California, p 169-178. 7 fig, 10 tab, 31 ref.

Field and greenhouse experiments with sludge and composted sludge as well as studies involving the analysis of sludges currently applied to agricultural land were conducted to investigate potential hazards associated with heavy metal uptake by plants. The results indicated that composting reduced the sludge metal availability to plants in addition to being desirable from the standpoint of pathogen reduction, odor control, drying, and ease of handling. Composting also generally produced a material which initially raised the soil pH and did not cause as much subsequent slow lowering of soil pH as digested sludge did. Plant cadmium uptake was extremely complex, depending on such factors as soil cadmium level, soil pH, the levels of other heavy metals in the soil, plant species and variety, and temperature. The experimental results indicate that the food chain should be adequately protected from sludge-borne cadmium if sludge use on cropland is restricted to only those sludges with a cadmium level equal to or less than 1% of the zinc content.

*Sludge disposal, *Plant tissues, *Heavy metals, *Food chains, *Cadmium, *Toxicity, Soil analysis, Soil chemistry, Soil treatment, Zinc

Composting

J150

ENVIRONMENTAL EFFECTS OF SLUDGE DISPOSAL IN SANITARY LANDFILLS,

Weddle, B. R.

United States Environmental Protection Agency,
Washington, D. C.

In: Proceedings of the 1975 National Conference on Municipal Sludge Management and Disposal, August 18-20, 1975, Anaheim, California, p 188-192. 1 fig, 3 tab, 1 ref.

The land disposal of sewage sludge involves growing controversy. Advocates of spreading sludge on farmland face increased opposition on the grounds that sufficient information does not exist on the human health implications from long-term low-level injection of crops grown on sludge amended soil. This lack of information about survival and movement of pathogens in groundwater and soils is being used to 'kill' proposed projects for sludge disposal and utilization. The portion of the problem of ultimate sludge disposal dealing with environmental effects of subsurface disposal of municipal waste water sludges is discussed. The principal conclusions of an investigation of the environmental and economic effects of disposing liquid sludge and septic tank pumpings into a sanitary landfill are included. It was concluded that the solid wastes generated by a city should have adequate capacity to absorb all the water in its liquid digested sludge. A second study was undertaken to evaluate the environmental impact of mixed sludge/solid waste and 'sludge only' disposal sites. Nine sites were selected, including a range of operational practices, geographical, and climatological conditions. Wells were drilled to sample leachate and gas at the sites. The first data was not available in time to be included.

*Pollutant identification, *Environmental effects, *Sludge disposal, *Landfills, *Land use, Sewage sludge, Public health, Soil contamination

Land application

J151

COMPOSTING RAW SLUDGE,

Epstein, E., and Willson, G. B.

United States Department of Agriculture,
Beltsville, Maryland,
Agricultural Research Service.

In: Proceedings of the 1975 National Conference on Municipal Sludge Management and Disposal, August 18-20, 1975, Anaheim, California, p 245-248. 2 fig, 2 tab, 8 ref.

Since windrow composting of raw sludge was previously tried and proved unsatisfactory, a forced aeration method was developed. The forced aeration system uses a pile of raw sludge mixed with woodchips or shredded bark to provide bulk. A vacuum is used to draw air through the pile. The pile is covered with finely screened compost from previous operations to prevent odoriferous gases from escaping into the atmosphere. Gases removed from the pile are scrubbed by passing through another pile of screened compost. This method of composting shows promise for controlling the odors associated with windrow composting of raw sewage sludge. The covering of screened compost ensures that all of the raw sludge reaches temperatures above the thermal death point of most pathogens. Measuring temperature and oxygen is the only monitoring required. The method can be adapted readily for use by either large or small sewage treatment plants. It requires only a modest investment in equipment.

*Treatment facilities, *Sewage sludge, *Aeration, *Air, *Air circulation, Odor, Gases, Temperature, Monitoring, Sewage treatment, Waste water treatment, Equipment

*Composting, Compost

J152

ENGINEERING STUDY AND FIELD DEMONSTRATION TRIALS FOR SAND DUNE STABILIZATION,

Ward, G. D.

George D. Ward and Associates,
Portland, Oregon.

In: Proceedings of the 1975 National Conference on Municipal Sludge Management and Disposal, August 18-20, 1975, Anaheim, California, p 200-203. 1 tab.

Organic wastes were used in soil stabilization studies in a severe wind erosion area in northeast Oregon. The first study involved soil building using fiberous wastes. Numerous solid wastes in various concentrations were incorporated into a sandblow, which was then planted with dryland grasses in late 1972 and evaluated in 1973. The second study applied on a larger scale the sand control procedures which were found effective during the first study. Physical stabilization and seeding procedures were undertaken during the fall of 1973 and early spring of 1974. The program is similar to programs in Israel, the Isle of Jersey in the English Channel, and the Lowry Bombing Range in Colorado. In Israel, shredded municipal waste is covered with a layer of sand, then reseeded with desert vegetation. On Jersey, composted and shredded municipal waste, blended with blowsand, is used for developing turf. In Colorado, Denver's total sewage sludge is used to build soil. A layer of the sludge, which is mechanically thickened, is deposited, plowed, disced, and then seeded. The result is healthy range grass which is productive and resistant to wind erosion. Organic wastes successfully used in Oregon include liquid sewage sludge, papermill sludge, shredded bark and woodwastes, and feedlot bedding. A nitrogen source such as sewage sludge or feedlot waste must be provided with papermill sludge.

*Dunes, *On-site tests, *Soil stabilization, *Organic wastes, *Wind erosion, Erosion control, Soil erosion, Oregon

J153

POTENTIAL HEALTH IMPACTS OF SLUDGE DISPOSAL ON THE LAND,

Love, G. J., Tompkins, E., and Galke, W. A.

United States Environmental Protection Agency,
Research Triangle Park, North Carolina.

In: Proceedings of the 1975 National Conference on Municipal Sludge Management and Disposal, August 18-20, 1975, Anaheim, California, p 204-213. 1 tab, 136 ref.

The potential for adverse human health effects associated with waste water treatment and disposal systems is related to many pathogens and other pollutants with multiple pathways to man. A wide variety of pathogenic bacteria, viruses, and parasites occur in sewage. Effluent and sludges both contain significant numbers of pathogens after primary treatment, but ozonation, pasteurization, gamma radiation, and chlorination can be used to kill pathogens. Pathogens can travel over fairly large distances in aerosols from sewage or sludge spraying, but seldom travel very far in soil. Possible routes of infection include groundwater contamination, aerosols, direct contact with contaminated environments, transmission by wild animals coming into contact with sewage or sludge, and infection of crops. The infectivity of virus appears high, and some routes of infection can involve the production of large numbers of bacterial cells. Little is known about the possible health effects from chronic ingestion of small quantities of organic and inorganic compounds and heavy metals. Obviously a potential for adversely affecting human health is associated with applying waste waters or sludge to agricultural lands. The degree of risk relates to soil types on which the materials are applied, the treatment of the wastes, and care exercised by individuals involved in treatment or land application. The greatest hazard would probably result from disrupting good treatment or sanitary practices. The use of waste waters and sludges to fertilize and irrigate crops in many areas suggests, despite associated disease outbreaks, that the practice can function safely. The limited quantities of essential chemicals and water available to produce food makes it necessary to find a safe use for waste water and sludge.

*Waste water treatment, *Sewage treatment, *Sewerage, *Public health, *Sludge disposal, Land use, Irrigation effects, Waste water (pollution), Sludge, Agriculture, Pathogenic bacteria, Viruses, Chemicals

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J154

FDA'S OVERVIEW OF THE POTENTIAL HEALTH HAZARDS ASSOCIATED WITH THE LAND APPLICATION OF MUNICIPAL WASTEWATER SLUDGES,

Braude, G. L., Jelinek, C. F., and Corneliussen, P.

Food and Drug Administration,
Washington, D. C.

In: Proceedings of the 1975 National Conference on Municipal Sludge Management and Disposal, August 18-20, 1975, Anaheim, California, p 214-217. 3 tab.

While proper use of good sludge on crops would not normally be expected to present a problem, contamination when sludges are improperly processed or applied on the wrong crops is of concern to the Food and Drug Administration (FDA). Direct physical contact with crops is a possible contamination mechanism. Contaminants may be retained in tissues of animals exposed when grazing or eating forage. Complete definitions of safe practices are currently unavailable due to insufficient data on the transfer of many contaminants through the food chain and on the toxicological effects to be expected. Many metals, including cadmium, are found at higher levels in crops grown on sludged soil than in controls in the same area. Sewage sludge contains persistent organic contaminants. Studies have shown that edible parts of plants contain these organics at levels 5 to 20% of the levels in the soils. The most likely contamination of foods would be in animals coming in contact with sludge and following failures of the sewage plant operation. The microbiologists feel crops eaten raw should not be planted within 3 yr of the last sludge application. Related FDA activities include surveys for heavy metals and pesticides in agricultural products, development of analytical methodology for heavy metals and pesticides, investigations on the survival of pathogens on vegetables grown in sludge treated soil, and toxicological studies to determine the effects of heavy metals and interaction between elements. There is currently no indication that sludge use must be limited to crops not in the human food chain or that all sludges are suitable for land application.

J155

PROCESSING, ECONOMICS AND SALE OF HEAT DRIED SLUDGE,

Stern, G.

United States Environmental Protection Agency,
Cincinnati, Ohio.

In: Proceedings of the 1975 National Conference on Municipal Sludge Management and Disposal, August 18-20, 1975, Anaheim, California, p 235-244. 4 fig, 7 tab, 34 ref.

Heat drying of municipal waste water sludge is reassessed. Undigested sludge can be heat treated to produce a useful product for agriculture and horticulture. Heat drying destroys most of the bacteria. Various types of direct heat dryers can be used. The energy requirements for producing equivalent amounts of nitrogen from sludge or commercial fertilizer can be comparable. While expensive, heat drying can be a relatively cheaper alternative to sludge disposal for many municipalities if the final product can be successfully marketed. Trends indicate that over one-third of the sludge to be produced in 1985 will be waste activated sludge, the kind that has been successfully marketed. Heat dried sludge sales are directed toward four major markets: industrial fertilizer compounders, citrus growers, nursery/horticulture/turf grass markets, and retail sales. Heat dried sludge offers slow-release organic nitrogen, other organics that improve the physical structure of soils, and trace elements such as zinc. Marketing heat dried sludge might best be done by a commercial firm. The rapid increase in commercial fertilizer cost is an added incentive to using heat dried sludge.

*Waste water treatment, *Activated sludge, *Treatment facilities, *Economics, *Drying, Municipal wastes, Waste water (pollution), Heat treatment, Horticulture

J156

PROCEEDINGS OF THE 1975 NATIONAL CONFERENCE ON MUNICIPAL SLUDGE MANAGEMENT AND DISPOSAL,

August 18-20, 1975, Anaheim, California. 257 p.

Various aspects of sludge treatment and disposal are discussed. Sludge disposal alternatives are considered for Philadelphia, Boston, Denver, and cities in general. The previous year's conference is updated, and another seminar is summarized. The disposal methods discussed include burning and disposal onto land. The discussion of land disposal includes its effects on plants, groundwater, and human health and its use in soil stabilization and improvement. Sludge digestion and treatment are also discussed. The treatment methods include the use of high energy radiation, heat drying, and composting. Other topics discussed include institutional problems of small treatment plants, a computer program to evaluate sludge handling and disposal costs, and energy conservation practices in municipal sludge management.

*Waste water treatment, *Pollutant identification, *Treatment facilities, *Conferences, *Municipal wastes, *Sludge disposal, *Sludge, Management

J157

IRRIGATION OF CORN WITH SIMULATED MUNICIPAL SEWAGE EFFLUENT,

Karlen, D. L., Vitosh, M. L., and Kunze, R. J.

Michigan Agricultural Experiment Station,
East Lansing,
Crop and Soil Science Department.

Journal of Environmental Quality, Vol. 5, No. 3, p 269-273, July-September, 1976.
4 fig, 6 tab, 25 ref.

A field study designed to evaluate the effects of applying 25, 50, 100, and 200 cm of simulated municipal sewage effluent to corn grown on a tile-drained loam soil was conducted. The results indicated that if effluents which are low in potassium and high in sodium are to be renovated through land disposal supplemental potassium must be applied. The experiment also demonstrated that the annual loading rate on a tile-drained Conover loam should not exceed 100 cm of supplemental effluent if efficient utilization of the applied nutrients through plant uptake is to be achieved. Nitrogen recovery through plant uptake at the 25-, 50-, and 100-centimeter loading rates exceeded 40% of the nitrogen applied through effluent and starter fertilizer when the corn was harvested as silage. Nitrogen uptake in the grain at these loading rates exceeded 50% in 1973 but was much lower the following year. The distribution of NO3 and Cl and the Cl/NO3 ratios suggested that much of the unrecovered nitrogen was denitrified.

*Irrigation effects, *Municipal wastes, *Sewage disposal, *Nutrient removal, Nitrogen, Potassium, Sodium, Plant growth, Corn (field), Loam, Denitrification

J158

DEMONSTRATION OF A PLANNING PERSPECTIVE FOR WASTE WATER SLUDGE DISPOSTION KNOXVILLE/KNOX COUNTY,

Neptune, D., Wyatt, M., and Heil, R.

United States Environmental Protection Agency,
Washington, D. C.,
Water Planning Division.

November, 1975. 177 p, 22 fig, 30 tab, 41 ref, 4 append. Technical Report PB-250 936.

The existing and future sludge disposal problem in Knoxville, Tennessee was investigated. The techniques employed in the projection of the present and future sludge quantities and qualities; selection of feasible sludge handling, transportation, and ultimate disposal or resource recovery methods; and the evaluation of these methods compiled into management plans were derived from a methodology previously developed by the Environmental Protection Agency. Six sludge management plans were found feasible for further consideration. They are sanitary landfill of a digested, dewatered sludge; trench-incorporation of a digested, dewatered sludge; incineration of an undigested, dewatered sludge from most treatment plants and sanitary landfill of a digested, dewatered sludge from two outlying plants; land application by spray irrigation of a digested sludge from most plants and landfill of a digested, dewatered sludge from an outlying plant; land application by composting and disking of a digested, dewatered sludge from most plants and landfill of a digested, dewatered sludge from an outlying plant; and producing fertilizer from digested sludge. None appear to present insurmountable problems in terms of meeting environmental constraints, performance criteria, or institutional and legal feasibility. However, the spray irrigation plan appears less cost-effective than the other five.

*Waste water treatment, *Sewage treatment, *Sewerage, *Analytical techniques, *Treatment facilities, Planning, Sludge disposal, Sludge, Waste disposal, Disposal, Management, Project planning, Cost analysis, Reclamation, Industrial wastes

J159

WASTEWATER RECYCLING ALONG TRANSPORTATION CORRIDORS,

Dove, L. A., and Rivers, E. G.

Black, Crow and Eidsness, Incorporated,
Engineers,
Clearwater, Florida.

Transportation Research Record, No. 571, p 28-35, 1976. 6 ref.

The feasibility and desirability of irrigating green spaces along transportation corridors with highly treated waste water is discussed, with particular reference to a zero-discharge, total-recycling waste water system for the city of Saint Petersburg, Florida. The system produces a virus-free waste water effluent that retains the valuable nutrients essential to plant growth. It is demonstrated that policies of the American Association of State Highway and Transportation Officials and Federal and state governments have established at least a permissive attitude on the use of treated waste water for irrigation of transportation corridors. Research on utility-accommodation policies and practices as well as on the feasibility and health effects of waste water recycling along transportation corridors is recommended. Applications involving the reuse of treated waste water for land disposal throughout the United States are reviewed.

*Waste water, *Water reuse, *Irrigation, *Transportation, *Institutional constraints, Reclaimed water, Recycling, Florida, Cities, Reclamation, Nutrients, Feasibility studies

Saint Petersburg (Fla)

J160

THE EFFECT OF DIGESTED SLUDGE ON SOIL BIOLOGICAL ACTIVITY,

Varanka, M. W., Zablocki, Z. M., and Hinesly, T. D.

Academy of Agriculture,
Wroclaw, Poland,
Soil Microbiology.

Journal Water Pollution Control Federation, Vol. 48, No. 7, p 1728-1740, July, 1976. 3 tab, 71 ref.

The effect of continuous heavy applications of digested municipal sludge to cropland on the main systematic groups of soil microflora and enzymatic activity was studied using soil samples from control and sludge-amended Blount silt loam soil. Anaerobically digested sludge was applied each year for 6 years to the amended soil, resulting in accumulative loading rates of 0, 92, 184, and 369 metric tons/hectare. No clear-cut restrictions in microbial populations and their activities were observed with the sludge-amended soil samples. Although total bacteria, fungi, and actinomycetes populations were never less in maximum sludge-treated plots, a significant increase in the populations for each of the major groups as a result of sludge application was recorded only once during three sampling dates. Percentage of denitrifiers, protease, and amylase activities were increased as a result of sludge application; while invertase and urease activities were unaffected by sludge treatment. Only the percentage of Azotobacter and cellulase activity were decreased by sludge treatment.

*Sludge, *Soil amendments, *Soil analysis, *Microenvironment, *Enzymes, Kinetics, Municipal wastes, Microbiology, Bacteria, Fungi, Actinomycetes

J161
WASTEWATER IRRIGATION - THE PRICE IS RIGHT,

Riha, B. J., and Mills, R. L.

Santa Rosa Public Works,
Santa Rosa, California.

American City and County, Vol. 91, No. 3, p 55-57, March, 1976.

A waste water reclamation program being developed by the city of Santa Rosa, California is described. The city has embarked on a full-scale waste water irrigation program by taking the entire discharge from its 6.5 million gallon/day West College Avenue treatment plant and distributing it to local dairy ranchers for the irrigation of about 1000 acres of pasture grass and feed crops. The city has also started construction on a major expansion of its Laguna waste water treatment plant; and when completed in early 1978, an additional 10 million gallons/day of effluent will be diverted to the land. The Laguna plant will also serve as a regional treatment facility for the entire Santa Rosa Plain. The regional reclamation plan will effectively achieve zero discharge of waste water to neighboring streams during the dry summer months. Effluent quality at the West College Avenue plant is high, with biochemical oxygen demand and suspended solids removal averaging 85%. The most probable number of coliform organisms does not exceed 2.2/milliliter. The plant diverts its effluent during about 6 months of the year to four holding basins spaced along a 6-mile gravity aqueduct which is bordered on both sides by dairy and beef cattle ranches. Standpipes along the route permit ranchers to tap the storage ponds for sprinkler or flood irrigation.

*Water reuse, *Reclamation, *Irrigation, *Waste water, *Reclaimed water, Municipal wastes, Farms, Treatment facilities, Projects, Construction, Regional development, Biochemical oxygen demand, Suspended solids, Dairy industry, Coliforms, California, Cities

Santa Rosa (Calif)

J162
INSPECTION MANUAL FOR THE ENFORCEMENT OF NEW SOURCE PERFORMANCE STANDARDS: SEWAGE SLUDGE INCINERATORS,

Devitt, T. W., and Kulujian, N. J.

PEDCo-Environmental Specialists, Inc.,
Cincinnati, Ohio.

February, 1975. 73 p, 2 fig, 6 tab, 14 ref, 3 append. Technical Report PB-246 112.

Guidelines are presented for field inspections to determine whether new or modified sewage sludge incinerators comply with New Source Performance Standards (NSPS). These are particulate emission and opacity standards for incinerators burning sludge produced by municipal waste water treatment facilities. Key parameters identified during the performance test are used for comparison during subsequent inspections to determine the facility's compliance status. Descriptions of the sewage sludge incineration process, atmospheric emissions from these processes, and emission control methods are included. A detailed discussion of the inspection methods and types of records to be kept is also provided. A survey of emission limitations in state implementation plans is presented.

*Waste water treatment, *Pollutant identification, *Analytical techniques, *Treatment facilities, *Sewage treatment, Incineration, Air pollution, Control, Inspection, Performance, Testing procedures, On-site tests

Air pollution control

J163
LET'S CONSIDER LAND TREATMENT, NOT LAND DISPOSAL,

Ulga, A.

Corps of Engineers,
Hanover, New Hampshire,
Cold Regions Research and Engineering Laboratory.

Civil Engineering-ASCE, Vol. 46, No. 3, p 60-62, March, 1976.

The use of land application for the treatment of waste water is discussed in terms of pretreatment requirements, disinfection requirements, application rates, hydraulic considerations, and economics. An engineered land treatment system can produce high quality potable water using simple pretreatment and limits the problem of disposing of sludges. Virus, pathogenic bacteria, and coliforms are completely removed by percolation through a 5-foot depth of soil under controlled slow infiltration design conditions. Survival times are typically a maximum of 2-3 months for organisms retained on soil particles. The application rate of waste water is limited by the nitrogen uptake potential of the vegetative cover; however, once this limitation is satisfied, as much water as possible should be applied to minimize costs, assuming no other limitations exist. The cost of land treatment is lower than that associated with the use of septic tanks for both rural and suburban areas.

*Waste water treatment, *Infiltration, *Water reuse, *Percolation, *Potable water, Economics, Nitrogen, Viruses, Pathogenic bacteria, Coliforms, Waste water disposal, Design criteria

Land application

J164
REGULATIONS: REACTIONS AND RESOLUTION,

Breidenbach, A. W.

Environmental Protection Agency,
Washington, D. C.,
Water and Hazardous Materials.

American Water Works Association Journal, Vol. 68, No. 2, p 77-82, February, 1976.
1 tab.

The Interim Primary Drinking-Water Regulations established by the Environmental Protection Agency in accordance with the Safe Drinking Water Act are discussed in terms of their development and objectives. Specific topics covered include: the applicability of the regulations to different types of public water systems, provisions in the regulations for sanitary surveys, the establishment of maximum contaminant levels, proposed requirements for measuring contaminant levels, the importance of quality assurance and record keeping procedures in relation to making the regulations effective, public comments received by the Agency concerning the regulations and proposed requirements, and the economic impact of the regulations. Total investment costs to community water systems in compliance with the regulations are estimated to be between $1.1 and $1.8 million. Noncommunity systems are expected to invest an additional $24 million.

*Legislation, *Potable water, *Regulation, *Water quality control, *Safety factors, Economics, Federal government, Monitoring, Quality control, Public health, Consumptive use, Water requirements

Safe Drinking Water Act, Interim primary drinking-water regulations, Environmental Protection Agency

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E036
Fukuda, T.
F014
Fukuzuda, T.
D003
Fuller, D. R.
D324
Fuller, W. H.
E105
Fulton, G. P.
D027
Furt, A, K.
E133
Gaines, F. R.
D245
Gale, R. S.
F029
Galke, W. A.
J153

NUMBER - LEFT RUNNING GHT

Gandhi, S. L.
D152
Gangoli, N.
D210
Gannon, J. J.
J115
Gardiner, J.
E143
Gardner, N.
D106
Garland, J. H. N.
A001
Gatti, G.
C087
Gaudy, A. F., Jr.
D156, D172
Gaynor, J. D.
J127
Geldreich, E. E.
E126
Gerba, C. P.
D136
Gerber, H. B.
D089, D108
Gevaudan, P.
D016
Ghosh, S.
D236
Giam, C. S.
E098
Gilbert, R. G.
D136
Gilbert, W. G.
D333
Gilman, H. D.
F024
Gilmore, R., Jr.
D149
Gitchel, W. B.
C002, C031, C083
Glass, G. E.
E121
Glaze, W. H.
E120
Goff, J. D.
D290
Goldman, J. C.
E012
Goldsmith, R. L.
D206
Gollan, A. Z.
D206
Goodnow, W.
B017
Gorton, P. A.
E010
Gottschling, R. D.
D086, D124, D184
Gould, J.
J121
Graber, K. L.
D068
Grady, C. P. L., Jr.
F059
Grandolfo, M. C.
E133
Gray, A. C., Jr.
D089
Green, L.
E050
Greenkorn, R. A.
F052
Greenlund, T. W.
D245
Gregorowicz, Z.
E024
Greifer, B.
E059
Grieves, R. B.
J051, J055
Griffin, L.
D151
Griggs, G. B.
E142
Grossman, A.
D062
Guarino, C. F.
F024
Guinan, D. K.
E107
Gunn, A. S.
D036
Gunn, I. W.
D100
Gupta, S. K.
D071

Gupta, S. P.
F052
Guthrie, R. K.
J075
Haddad, R.
E080
Hadden, L. C.
C035
Hagarman, J. A.
A008
Hahn, H. H.
J045
Haith, D. A.
J119
Hakimipour, M.
A017
Halstead, R. L.
J127
Hamilton, C. E.
E025
Hampton, N. F.
H007
Hampton, Q. L.
C081
Hancock, N.
B021
Hanisch, B.
D131
Hannaman, M. C.
J102
Harlin, C. C., Jr.
D177
Harremoes, P.
D170
Harris, D. J.
E078
Harrison, R. M.
E017
Hartman, W. J.
D024
Hassan, M.
F062
Hatada, H.
D006
Hathaway, S. W.
D161
Haug, L. A.
C082
Hausberg, D. E.
D203
Hayakawa, N.
F014
Haydt, W.
D213
Hayes, J. V.
J029
Heaney, J. P.
A010
Hebert, V.
E046
Heertjes, P. M.
D105
Heesen, T. C.
E074
Hegemann, W.
D159
Heidman, J. A.
D342, J132
Heil, R.
J158
Heizer, R. E.
J125
Heler, J-J.
F027
Henderson IV, J. E.
E120
Hendricks, G. F.
D274
Henseler, G.
D120
Herik, A. G.
B020
Hershaft, A.
J047
Hess, H. V.
C073
Hiasa, T.
D008
Highfill, J. W.
E060
Hill, D. R.
C067
Hill, F. B.
E141
Hinesly, T. D.
J160

NG

BER-RIGHT

Hinkley, J. R.
J069
Hinwood, J. B.
F053
Hirase, F.
J002
Hiroi, K.
D007
Hirs, G.
C047
Hitchcock, K. W.
D029
Hitte, S. J.
D039
Hodd, S. L.
F041
Hofstader, R. A.
E133
Hoigne, J.
E052
Hoodley, A. W.
J121
Hoot, F. M.
D273
Hopkins, D. R.
J064
Hopkins, T. S.
E142
Horrell, D. R.
D203
Horsefield, D. R.
D290
Hortenstine, C. C.
J144
Hotz, K.
D345
Howard, P. H.
E112
Howe, R. H. L.
D059
Hsu, D. Y.
D051
Hsu, P. H.
D070
Huber, W. C.
A010
Huggett, R. J.
E044
Hughes, G. M.
H012
Hulls, J. R.
C054
Humenik, F. J.
D105
Humphrey, M. F.
D080
Hung, Y-T.
D090, E006
Hunsicker, M.
D291
Hunt, P. G.
D180
Hunt, W. G.
C071
Husiman, P. H.
C017
Huston, M.
E106
Hyde, H. C.
J008
Hylton, A. R.
J137
Iambert, W. P.
D205
Ikenata, A.
D009
Inhaber, H.
E092
Inoue, K.
C074
Ireland, C. W.
J120
Irizarry, M. M.
D195
Ishiguro, M.
D004
Isnimaru, H.
D008
Ito, J.
D032, D033
Itoga, H.
C088
Iwasaki, I.
J054
Jacobs, S. A.
E135

Jain, R. K.
F021
Jamshidnia, G.
A017
Jelinek, C. F.
J154
Jenkins, D. W.
E005
Jenkins, R.
E039
Jenkins, S. H.
J025
Jensen, C. E.
E072
Jeris, J. S.
C008, C055
Jethwami, M.
B035
Joeres, E. F.
D283, F056
Johnson, D. L.
C060
Johnson, J. S.
D308
Johnson, T.C.
C105
Johnson, W. K.
D325
Johnston, H. K.
F067
Jolley, R. L.
D280
Jones, G.
D280
Jones, G. L.
D000
Jones, J. E.
J059
Jones, J. R.
D295
Jones, R. H.
D276, D327
Jorgensen, S. E.
D008
Josti, J.
D049
Kaelin, J. R.
C076, C085, C091
Kapoor, S. K.
D323
Kardos, L. T.
J021
Karlen, D. L.
J157
Karr, P.
E131
Kataoka, T.
J002
Kato, T.
J002
Kaul, S. N.
J023
Kawabe, K.
D007
Kawam, A.
J030
Kawata, K.
D148, E013
Keay, W. L.
F040
Keeney, D. R.
D052, D326
Keffer, W. J.
E078
Kepple, L. C.
D196
Kerfoot, W. B.
E135
Kershaw, M. A.
D097
Kibler, J. F.
F020
Kim, B. R.
D241
Kincannon, D. F.
D061, D139, D175
King, C. J.
E088
King, M. V.
B033
King, R. P.
D099, D259
Kirk, B. S.
C030
Kitao, T.
D008

RUNNING HEAD NUMBER-RIGHT

Klatt, L. N.
E103
Kleber, E. V.
C058
Klee, A. J.
F050
Klemas, V.
E086
Kleper, M. H.
D206
Klingensmith, R. S.
J125
Klingman, E. D.
E041
Kloster, H.
C063
Klute, R.
J045
Knoeck, J. W.
E028
Knopp, P. V.
C002, C031, C083
Kobayashi, S.
J013
Kobayashi, T.
D001
Kobori, K.
J001
Kobus, H.
J026
Kohn, P. M.
J133
Koike, Y.
D301
Kollias, P. S.
D229
Komori, S.
D301
Konikow, L. F.
F037
Kontur, I.
A004
Koplyay, T. M.
A002
Koppel, L.
F059
Kopperman, H. L.
E121
Kormanik, R. A.
F012
Korte, N. E.
E105
Koscielniak, H.
D062
Koster, E. L. C.
D110
Kostovetskiy, Ya. I.
D011
Kraus, K. A.
D308
Kraus, M. P.
E108
Krauth, K.
A006
Kretch, C. J. H.
D187
Krishnan, P.
D172
Kropf, F. W.
J034
Krul, J. M.
E022
Kruse, C. W.
E013
Ku, H-C.
D254
Kubelka, V.
E058
Kuehl, D. W.
E121
Kugelman, I. J.
E118
Kuhns, R. E.
D271
Kulujian, N. J.
J162
Kunze, R. J.
J157
Kuo, P. P. K.
D270
Kusznik, W.
D062
Kuwayama, K.
J003
La Clair, L. M.
C080

NG NUMBER-RIGHT

Labouteur, P.
E031
Lagerwerff, J. V.
E048
Lance, J. C.
J114
Landreth, R. E.
J046
Lang, M.
B035
Lappo, R. L.
D215
Larew, H. G.
J030
Larkin, E. P.
D239
Larson, T. E.
D337
Laseter, J. L.
E050
Lauch, R. P.
E124, E127
Lawrence, A. W.
E133, J074
Lebo, W. R.
C078
Lechner, J. F.
E045
Lee, C. R.
D180
Lee, G. F.
A011
Legan, R. W.
D152
Legeron, J. P.
E033
LeGrand, H. E.
H009
Leidner, H. A.
F001
Leisch, B.
E134
Lemieux, P. F.
F011
Lenhart, C. F.
D277, D330, D340
Lensi, R.
D225
Leseman, W. G.
F039
Leu, J.E.
D035
Lewis, D. H.
D066, D134
Lewis, F. M.
D321
Lexzozynski, W.
E024
Leytham, K. M.
F028
Li, E. C. C.
D118
Liang, T.
E083
Liberti, L.
E042
Libor, O.
D068
Lidkea, T. R.
D142
Light, E.
D182
Liles, A. W.
C094
Lim, H. C.
F059
Lim, H. S.
F067
Lindholm, O. G.
B026
Lines, R. W.
E038
Lischke, P.
E057, E058
Liseth, P.
D256
Litwin, Y. J.
F066
Lo, C. P.
E016
Lodholz, J. C.
D030, D185
Loehr, R. C.
D168, D263
Logan, T. J.
J138

NUMBER - LEFT RUNNING GHT

Logsdon II, O. J.
E106
Loken, P. A.
C051
Long, D. A.
D024
Longman, R. W.
F026
Lopez, B.
D015
Loucks, D. D.
J123
Love, G. J.
J153
Lum, G. T.
F005
Lumb, A. M.
F009
Lund, L. J.
E014
Lutrick, M. C.
J009
Lutz, J. J.
B015
Lysyj, I.
E075
Mace, G. R.
D198, D199, J143
Machida, M.
D006, J004
Mack, D.
D151
MacNaughton, M. G.
D269
Madsen, M. J.
E102
Magara, Y.
E051
Magdoff, F. R.
D052
Mage, D. T.
F038
Maggiore, C. J.
E100
Maglicova, A.
E057
Maguet, G. J.
D289
Mahdy, M. S.
J087
Mahler, R. J.
J060
Mahlman, H. A.
D308
Mair, D. M.
J024
Mallet, M. N.
D016
Mancy, K. H.
J011
Manickam, T. S.
D156
Manley, W.
D188
Manthe, R. M.
D204
Marinenko, G.
E044
Marlow, K. C.
E021
Marr, G.
F031
Martens, D. W.
J086
Martin, E. J.
B036
Martin, G.
A007
Martin, M. J.
D058
Martin, W. J.
J146
Martinson, S.
E026
Marukawa, H.
C088
Mason, A. K.
E091
Mason, D. G.
C039
Masters, H.
A015
Masuda, S.
D004
Matotan, W. I.
D244

RUNNING HEAD NUMBER-RIGHT

Matson, J. V.
D173
Matsumura, T.
D003
Matsuoka, T.
J003
Matthess, G.
H002
Matulewich, V. A.
E111
Mauk, C. E.
D152
Maurel, A.
E090
Mayer, V.
D131
McCammon, R. B.
E101
McCarthy, P. L.
F032
McCormick, J.
J148
McCoy, C. J.
D257
McDermott, D. J.
E074
McDonald, N.
B017
McDonald, R. C.
D329, D344
McGauhey, M. G.
D305
McGauhey, P. H.
J140
McGuire, J. M.
E084
McIntyre, N. S.
J053
McJunkin, F. E.
J067
McKnight, C. E.
J092
McLaren, D. A.
E005
McMillion, L. G.
J042
McMurtrey, D.
J141
McNulty, K. J.
D206
McWhirter, J. R.
C080
Medina, M. A.
A010
Meier, P. M.
F051
Mentink, A. F.
E137
Metry, A. A.
H004
Meyers, R. O.
F045
Michel, E.
D338
Middleton, A. C.
J074
Miele, R. P.
D331
Millbank, P.
D237
Miller, G. W.
D314
Miller, J. D.
E089
Miller, R. G.
D125
Miller, R. H.
J138
Millette, J. R.
E062
Mills, R. L.
J161
Millward, R. S.
C065
Minton, G. R.
D334
Miorin, A. F.
J125
Mitchell, D. G.
E020
Mitchell, G. A.
J060
Mitchell, T. M.
D260
Moeller, J. R.
D282

VG

BER-RIGHT

Moffa, P. E.
    A003
Montague, A.
    J145
Morgan, G. B.
    E099
Morgan, J. E.
    C096
Morgan, J. J.
    E066
Mori, M.
    D255
Morin, D. C.
    F041
Morlot, M.
    E030
Morris, J. C.
    D150
Morris, M-E.
    D111
Morrow, J. J.
    D293
Mosey, F. E.
    E047
Motozwata, S.
    C088
Mowat, A.
    E104
Mozzi, G.
    D225
Mueller, H. F.
    D337
Mueller, J. A.
    C008, C055
Mukai, S.
    J052
Mullen, D. C.
    D171
Mullen, K. T.
    J031
Murphy, D. S.
    C020
Muszynski, W. J.
    J020, J112
Nagata, Y.
    F002
Nagel, C. A.
    D275, E145
Nakamura, K.
    D032, D033
Nakayama, K.
    D010
Nambu, S.
    E051
Naparstek, J. D.
    D148
Natarajan, K. A.
    J054
Nebel, C.
    D086, D124, D184
Neff, G. S.
    E098
Negaard, J.
    D031
Negoro, Y.
    J005
Nelson, C. O.
    E014
Nelson, D. W.
    E041, E140
Nelson, K.
    C021
Neptune, D.
    J158
Neptune, M. D.
    D332
Nesbitt, P. M.
    J027
Nettli, P.
    C018
Newton, D.
    D323
Nicholson, W. J.
    E100
Niebla, E. E.
    E105
Nishimura, Y.
    C077
Noicnl, O. J.
    C056
Norgrove, W. B.
    D072
North, R. M.
    J070
Norton, R.
    J091

NUMBER - LEFT RUNN GHT

Novotny, F.
B035
Novotny, V.
F061
Noz, F. J.
F005
O'Brien, W. J.
D234
O'Donnell, J. M.
C015
O'Neill, H. J.
D086, D124, D184
Oberacker, D. A.
J040
Oberteuffer, J.
D201
Ochi, S.
J001
Ogedengbe, O.
D067, D335
Ohara, G. T.
D322
Oleckno, W. A.
J015, J017
Olenik, T. J.
J020, J112
Olexsey, R. A.
D161, D320
Olgac, N. M.
F026
Olivieri, V. P.
D148
Olivotti, R.
D091
Olson, R. L.
D249
Olsson, G.
F042
Olufeagba, B. J.
F049
Omata, I.
D007
Othmer, D. F.
D286
Otis, R. J.
D243
Otstavnor, A. A.
B001
Ott, W. R.
F038
Ou, L-T.
E112
Overath, H.
F031
Overman, A. R.
D254, F039
Ozolins, G.
E071
Pacaud, J.
C032
Packer, M.
D236
Page, A. L.
E014, H013, J060
Paintal, A. S.
B018
Pakalns, P.
E043
Palmlund, I.
E096
Panzer, H. P.
C057
Parhad, N. M.
J134
Parker, D. S.
C045, D240
Parker, W. J.
J095
Pascarella, G.
C072
Passino, R.
E042
Patterson, J. W.
J096
Paul, P. E.
D089, J131
Pause, R. W.
E020
Pawlita, W.
D062
Pecar, V.
E035
Peil, K. M.
E060
Peirce, J. J.
F056

RUNNING HEAD NUMBER-RIGHT

Peleg, M.
D123
Pennington, D.
J148
Pentz, H.
D030, D185
Penumalli, B. R.
F054
Perez, J. W.
J050
Perry, R.
E017
Petrasek, A. C., Jr.
D207, D238, D246
Pettry, D. E.
J012
Pfeffer, J. T.
D266
Philipson, W. R.
E083
Pickering, R. J.
E070, F006
Pijanowski, B. S.
E097
Pillai, S. C.
D129
Pipes, W. O.
F033
Pitcairn, F. U.
J083
Pitt, W. W.
D280
Plewes, M. E.
J093
Plock, C. E.
D203
Poepel, F.
D122
Poertner, H. G.
A016
Poltorak, R. L.
D305
Poon, C. P. C.
D042
Popalisky, J. R.
J141
Porcella, D. B.
J140
Posselt, G.
J111
Post, D. F.
H003
Pound, C. E.
D178, D186
Poustis, J.
A007
Powe, C. M.
C097
Prakasam, T. B. S.
D168, D263
Prange, C. J.
C003
Pratt, P. F.
H013
Prefer, E. H.
B014
Prettyman, R. W.
D196
Preusser, G.
C063
Pringle, B. H.
D154
Pulkkinen, E.
D109
Purdy, K. L.
E089
Pusz, I.
D063
Radusch, P.
C063
Radziul, J. V.
E095
Rakhov, G. M.
D011
Raman, V.
J023
Ramaswamy, J. N.
D341
Ramia, S.
J129
Ramirez, E. R.
C060, C090
Rana, D. S.
E128
Randall, C. W.
E008, F008

VG

-RIGHT

Rao, N. U.
J134
Rasmussen, J.
J137
Ray, M. W.
C042
Ray, W.
D094
Raynor, G. S.
J029
Razeghi, N.
A017
Recht, H. L.
C058
Recht, P.
J062
Reddy, M. P.
D156
Redekoppk A. B.
J088
Redmon, D. T.
D144
Reece, J. D.
J141
Rees, S. M.
D274
Reeves, J. R.
E019
Reid, R. O.
F048
Rendic, D.
E035
Reneau, R. B., Jr.
J012
Reuter, L. H.
D205
Reynolds, B. J.
J081
Reynolds, M. A.
D035
Rhett, J. T.
J078
Ricci, L. J.
D307
Rice, I. M.
D208
Rice, R. C.
D136
Rich, D. F.
E131
Rich, L. G.
D045, D128, E029, F043
Ricoy, J. L.
D244
Riha, B. J.
J101
Rios, R. A.
F023
Rivers, E. G.
J159
Roberts, F.
D074
Roberts, W. F.
J130
Robinson, R. M.
J094
Robson, C. M.
D316
Roeber, J. A.
D273
Roesel, H.
D117
Roesler, J. F.
E118
Rogan, P. D. M.
C097
Rohatgi, N. K.
J124
Romanowski, J. W.
C093
Rorrer, D. E.
J095
Rosen, R. H.
E069
Roskopf, R. F.
J102
Ross, J.
J030
Ross, W. L.
C080
Roulier, M. H.
J046
Rubin, I. B.
E100
Rucks, A. C.
J098

Rude, L.
J030
Ruffo, C.
E056
Rugg, D. D.
J043
Ruopp, D. J.
E068
Safferman, R. S.
D111
Saffran, E. P.
F012
Saidi, H.
D156
Saito, K.
J001
Saleh, M.
D069
Salvemini, F.
C072
Samar, P.
A017
Samowitz, C.
B035
Sampayo, F. F.
D028
Sanders III, W. M.
E082
Sanga, S.
C077
Sangrey, D. A.
E083
Sarai, M.
A017
Sarfert, F.
E064
Sargent, R.
D201
Sattar, A.
J129
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Water and Sewage Works

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Water Pollution Control

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